# MPS 48 and MPS 48 Dial

Racal-Milgo™

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4404D66B1/G1 3/82

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# Installation and Operation

# MODEMS
# MPS 48
# AND
# MPS 48 DIAL

Racal-Milgo™

**Racal-Milgo Information Systems, Inc.**
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**4404D66B1/G1 3/82**

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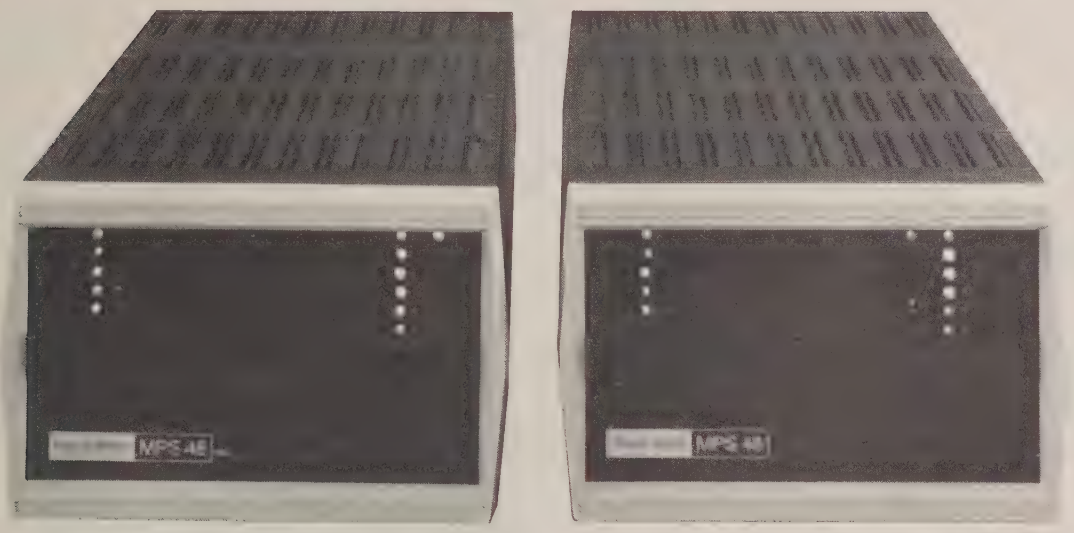
**WARNING**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

# SPECIFICATIONS




4D66B481333

*Frontispiece: Modems MPS 48 and MPS 48 DIAL, Part Number 4404-66X.*

## DIMENSIONS AND WEIGHTS

TABLE TOP MODEM

Height . . . . . 5.12 inches (13.0 cm)
Width . . . . . 8.0 inches (20.32 cm)
Depth . . . . . 18.91 inches (48.03 cm)
Weight . . . . . 15 lbs. (6.80 kg), approximately

RACK MOUNTS

Height
(including lower ventgrille) . . . . . 6.49 inches (16.48 cm)
Width
(rack standard width) . . . . . 19.0 inches (48.26 cm)
Depth
(rack standard depth) . . . . . 19.0 inches (48.26 cm)
Weight
(Single-Modem Assembly) . . . . . 17.0 lbs. (7.71 kg), approximately

Weight
(Dual-Modem Assembly) . . . . . 32.0 lbs. (14.51 kg), approximately

## POWER REQUIREMENTS

Modem MPS 48 or MPS 48 DIAL may be equipped with one of five power supplies available (refer to Modem Power Supply Configurations).

(a) For domestic (USA) applications, power supplies operate at 105-125 Vac; 47-65 Hz. Power consumption is 60 watts, maximum.
(b) For foreign country applications, power supplies operate at 89-107 Vac, 182-218 Vac, 200-240 Vac or 218-262 Vac; 47-65 Hz. Power consumption is 60 watts, maximum.

**DATA TRANSFER RATE**

Information is transmitted and received at a rate of 4800 bps, synchronous.

**TRANSMISSION LINE REQUIREMENTS**

Modem MPS 48 operates on 2-wire (half-duplex) or 4-wire (full-duplex) circuits over any of the following transmission line facilities:

(a) Type 3002 unconditioned, private (leased) lines.

(b) Conditioned lines (C1, C2, or C4). These lines may be used, but are not required.

Modem MPS 48 DIAL operates on 2-wire (half-duplex) or 4-wire (full-duplex) over public switched (DDD-PSTD) telephone line networks.

**INTERFACE**

Modems MPS 48 and MPS 48 DIAL conform to the interface specifications defined in EIA-RS232C/CCITT, V.24.

**TRANSMITTER**

DATA INPUT

| | |
|---|---|
| Format | Serial binary data. |
| Amplitude | EIA-RS232C/CCITT V.24 ± 3V to ± 25V; (+) = 0 = space; (−) = 1 = mark. |
| Input Line | Single wire, ground return. |
| Input Load | 3000 - 7000 ohms. |

OUTPUT TO LINE

| | |
|---|---|
| Output Signal | Differential phase shift keying of an 1800 Hz carrier. At 4800 bps data rate, the carrier is 8-phase modulated (V.27 compatible). |
| Carrier Center Frequency | 1800 Hz ± 0.01%. |
| Modulation Rate | 1600 baud. |
| Scrambler | V.27 compatible. |
| Output Level | Strap adjustable, in 1 dB increments, from + 1dBm to − 18dBm. |

| | |
|---|---|
| Output Impedance | 600 ohms, nominal; balanced. |
| Squelch Level | 50 dB below transmit output level. |
| CLOCK | |
| Waveform | Squarewave; negative going edges coincide with center of data bits. Positive going edges coincide with change of input data. |
| Frequency | For external use; fixed 4800 Hz, 50% ± 1% duty cycle. From external source 4800 Hz 50% ± 5% duty cycle. |
| Accuracy | ± 0.01%. |
| Amplitude | For external use: EIA-RS232C/CCITT V.24, V.26; standard, ± 10V ± 1V from approximately 300-ohm source. From external source: EIA-RS232C/CCITT V.24 standard, ± 3V to ± 25V into 3000 to 7000 ohms. |

**RECEIVER**

| | |
|---|---|
| INPUT FROM LINE | |
| Input Signal | Differential 8-phase DPSK modulation on an 1800 Hz carrier CCITT V.27 compatible. |
| Input Impedance | 600 ohms, nominal; balanced. |
| Input Level | 0dBm to – 48dBm in two strap selectable ranges: Range 1: (Private Line) 0dBm to – 30dBm; DCD pull-in at – 27dBm. Range 2: (Dial-up Line) – 16dBm to – 48dBm; DCD pull-in at – 37dBm. Range 2 will accomodate 0dBm to – 40dBm receive line levels when the modem is configured to receive a constant carrier. |
| DATA OUTPUT | |
| Format | Serial binary data. |
| Amplitude | EIA-RS232C/CCITT V.24. |
| Output Line | Single wire, ground return. |
| Output Impedance | Approximately 300 ohms. |
| CLOCK | |
| Waveform | Squarewave; negative going edges coincide with center of data bit; positive going edges coincide with change in output data. Derived from received signal. |

| | |
|---|---|
| Frequency | Equal to data bit rate; synchronized with the remote transmitter clock. |
| Amplitude | For external use; EIA-RS232C/CCITT V.24. |
| Tracking Capability | The receiver bit-serial timing circuits track the received clock frequency of 4800 bps, with up to ± 0.01% variations. |
| **SELECTABLE FUNCTIONS** | |
| TRANSMITTER | |
| RTS-CTS Delay (Strap Selectable) | Standard: Switched carrier direct (no repeater) 26 ms. Optional: Switched carrier through repeaters 65 ms. Switched Carrier through dial lines with excessive echoes, 125 ms. Continuous carrier (4-wire only) 0 ms or 20 ms. |
| Carrier Control | 5 ms on to off delay. |
| RECEIVER | |
| DCD Delays Dropout | 5 to 15 ms. |
| Return Recovery | 26 ms. |
| CARRIER CONTROL (RCC) | |
| Squelch Delay | None. |
| Unsquelched Delay | 17 ms standard; 40 and 80 ms optional (used with dial lines having excessive echoes. |

# SECTION 1

# INTRODUCTION

## GENERAL INFORMATION

The Micro Processor Series MPS 48 and MPS 48 DIAL are modems manufactured by Racal-Milgo, Inc., Miami, Florida. Basically, a modem converts digital information into an analog signal, and the analog signal into digital data. In this manner, two distant data processors can exchange their digital data through a modem installed at each end of the transmission line.

Common to both MPS 48 and MPS 48 DIAL are the transmit, receive and interface functions of the basic modem, explained in BASIC MODEM FUNCTIONAL DESCRIPTION. Modem feature designations are established by special functions added to the basic modem. Thus, MPS 48 identifies Features A, B and C. And MPS 48 DIAL identifies Feature D which is designed to operate on dial-up networks. Refer to MODEM CONFIGURATIONS.

The modems operate at a data speed rate of 4800 bits per second (bps). Modem MPS 48 operates in 4-wire full-duplex over private (leased) line service, type 3002 unconditioned, of CCITT M102 grade. Conditioned lines, C1, C2 or C4, may also be used but are not required. Modem MPS 48 DIAL operates in 4-wire, full-duplex or 2-wire, half-duplex over public switched (DDD-PSTN) networks.

In either Modem MPS 48 or MPS 48 DIAL, circuit design and operation meet European protective requirements (CCITT, BPO, and Belgian RTT), as well as UL requirements. The modems are compatible with any other modem which also operates on continuous carrier, according to CCITT V.27.

Modems MPS 48 and MPS 48 DIAL initiate data transmission with a unique training sequence which occurs during the RTS-CTS delay interval. This training sequence synchronizes the modem receiver within 26 ms. When using a different transmitting modem not providing the training sequence, the MPS 48 receiver may require up to 3 seconds to synchronize on the received line signal.

## BASIC MODEM FUNCTIONAL DESCRIPTION

The basic modem (Figure 1-1) contains conventional DTE (data terminal equipment) Interface and Transmission interface circuits. However, the Transmitter and Receiver circuits provide signal processing by advanced digital techniques which improve data transfer accuracy and overall performance reliability.

**Transmitter** - Information from the DTE enters the transmitter circuits as synchronous, serial, binary data, at a transfer rate of 4800 bps. To prevent transmission errors due to standing data patterns, the data is scrambled according to CCITT, V.27 standards.

The timing and control circuits of the transmitter not only provide the clock function, but also generate control signals, in a training sequence, which permit fast (26 ms) synchronization at the receiving modem.

The 1800 Hz carrier is 8-phase modulated by tribits (three bits at a time) of the 4800 bps data. The modulated carrier conveys the information through transmission line.

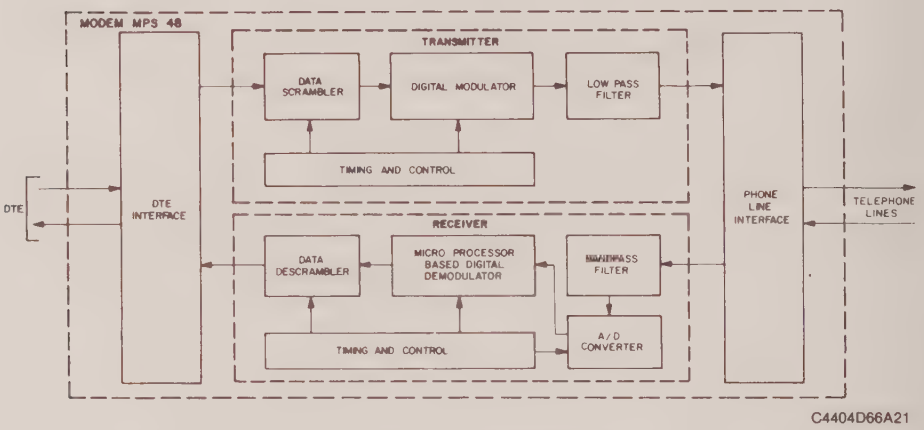



*Figure 1-1: Modem MPS 48, Simplified Block Diagram*

**Receiver** - From the transmission line interface, the receive signal reaches the bandpass filter and the analog-to-digital converter stages in the receiver. The demodulation functions are performed by a built-in microprocessor which includes an equalizer stage. Also included is a signal quality generator, which indicates relative signal strength displayed by lamps 2, 3, 4, 5 on the front panel. The digital output from the microprocessor is descrambled into the originally transmitted pattern and is transferred serially, through the DTE Interface to the DTE.

**Equalizer** - Inherent passband characteristics of the transmission lines may result in phase and amplitude distortion of the modulated carrier. To compensate for this distortion, Modems MPS 48 and MPS 48 DIAL contain a statistical equalizer circuit connected to the receive path. Selectable straps compensate for phase and amplitude, as may be necessary in special cases of highly distorting lines.

**Clock Circuits** - The transmitter and receiver have their own, independent crystal oscillator to provide timing control.

**Interface** - Modems MPS 48 and MPS 48 DIAL interfaces with the telephone line and the DTE perform in accordance with standard interface parameters, as defined by EIA-RS232C/CCITT, V.24 and V.27.

## PHYSICAL DESCRIPTION

Modems MPS 48 and MPS 48 DIAL (Frontispiece) are available in a table-top unit with a removable front bezel. Two smoked plexiglass, sliding doors in the bezel protect controls and indicators on the front panel.

The modem back panel (Figure 1-2) has connector receptacles (J1 and J2) for external cables, captive power line cord, transmission line terminal block, fuse, and POWER ON/OFF switch.

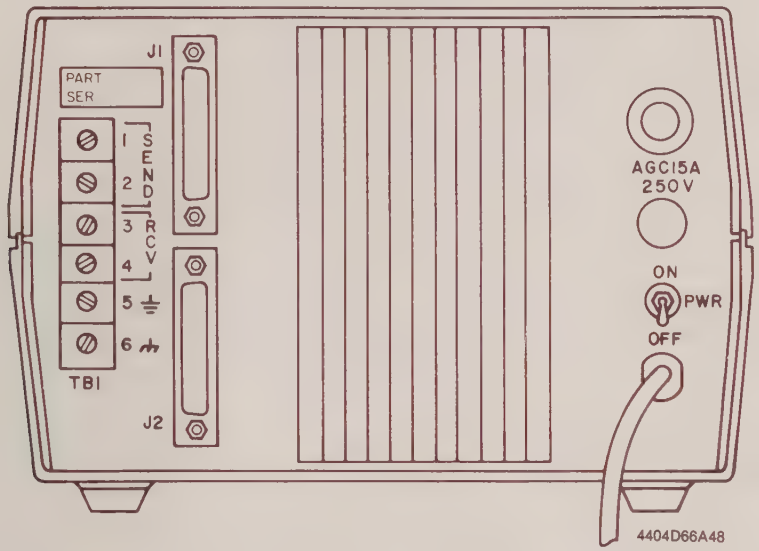



*Figure 1-2: Modem MPS 48, Rear Panel*

Remove the front bezel by loosening a top and a bottom captive screws, and pressing on top and bottom of the bezel. With the bezel removed, (Figure 1-3), 12 slots (labelled N1 through N12, left to right) are exposed inside the modem case. These slots serve to front load up to 12 PC (printed circuit) cards into the modem. The PC cards plug into receptacles of a wire-wrapped backplane. This backplane interconnects the PC cards and connects to receptacles and wire terminations of the rear panel.

Slot assignments for the PC cards are given in MODEM CONFIGURATIONS.

The modem power supply is installed between the backplane and the rear panel.

A Rack Mount Kit, Part No. 4404-174A-1, optionally available, permits Modems MPS 48 and MPS 48 DIAL to be rack mounted at the customer installation. The kit is adaptable to either single-modem mount across the rack or side-by-side, dual-modem mount across the rack. Refer to Section 3, INSTALLATION PROCEDURES.

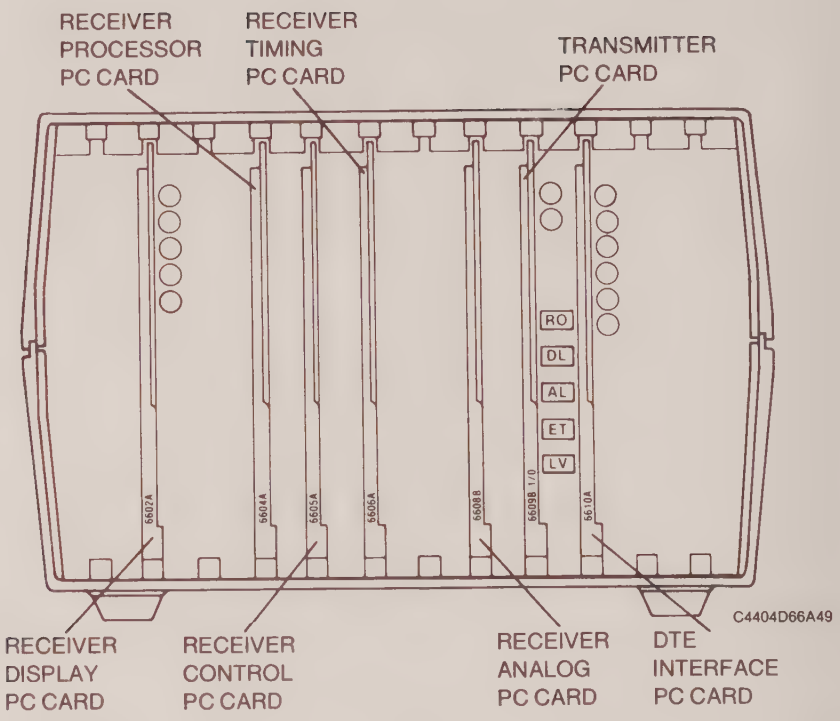



*Figure 1-3: Modem MPS 48, Basic PC Card Complement, Card Locations*

## MODEM CONFIGURATIONS

### GENERAL DESCRIPTION

Modem MPS 48 is made available not only with the basic functions described in BASIC MODEM FUNCTIONAL DESCRIPTION, but also with a wide selection of special, added functions.

The basic modem functions require a complement of seven plug-in PC cards which are necessary in all configurations of the MPS 48 modem.

(a) A Jumper PC Card, Part No. 4404-6601B-0, must be inserted into Slot 1 of Modem MPS 48 Models 4404-66C or 4404-66D whenever the M2 + Y4 options are not used.

(b) Receiver Display PC Card, Part No. 4404-6602A - Slot N2.

(c) Receiver Processor PC Card, Part No. 4404-6604A - Slot N4.

(d) Receiver Control PC Card, Part No. 4404-6605 - Slot N5.

(e) Receiver Timing PC Card, Part No. 4404-6606A - Slot N6.

(f) Receiver Analog PC Card, Part No. 4404-6608B - Slot N8.

(g) Transmitter PC Card, Part No. 4404-6609C1 - all Feature B configurations.

Transmitter PC Card, Part No. 4404-6609C2 - Feature A.

Transmitter PC Card, Part No. 4404-6609C3 - Feature C.

The transmitter PC Card is installed in Slot N9.

(h) DTE Interface PC Card, Part No. 4404-6610C-1 - used in all MPS 48 modems without the M2 PC Card.

DTE Interface PC Card, Part No. 4404-6610C-2 - used in MPS 48 modems with the M2 PC Card.

The DTE Interface PC Card is installed in Slot N10.

(i) Jumper PC Card, Part No. 4404-6601B-0. This jumper card must be inserted in Slot 1 of all modems, except Feature A + M2 and A + M2 + Y4 modems.

The special functions are also provided in plug-in PC cards which are installed in the modem to form Feature A, Feature B, Feature C and Feature D modem configurations. See Table 1-1.

FEATURE A MODEMS

These modems have the remote test capability for 4-wire, Point-to-Point networks. The basic seven PC card complement includes Transmitter PC Card Part No. 4404-6609C2.

**Feature A** - Basic card complement plus Remote Point-to-Point Test PC Card, Part No. 4404-6611C-3. (Slot N11). See Figure 1-4.

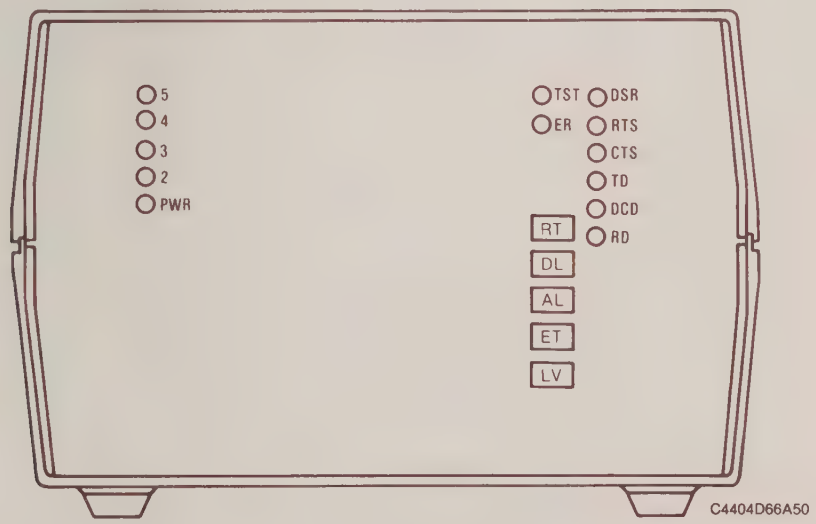



*Figure 1-4: Feature A Modem, Front Panel*

**Feature A + M2** - Same as Feature A, plus Dual-Channel (M2) PC Card, Part No. 4404-6601A1 (Slot N1). See Figure 1-5.

**Feature A + M2 + Y4** - Same as Feature A, plus Dual-Channel and RTS/DCD Simulation (M2 + Y4) PC Card, Part No. 4404-6601A2 (Slot N1). See Figure 1-5.

**Remote Point-to-Point Test** provides 390 Hz or 450 Hz tone transmission and reception; so that, in a 4-wire point-to-point network, the modem at one end can command the modem at the other end to go into digital loopback (390 Hz tone) or analog loopback (450 Hz tone) test mode.

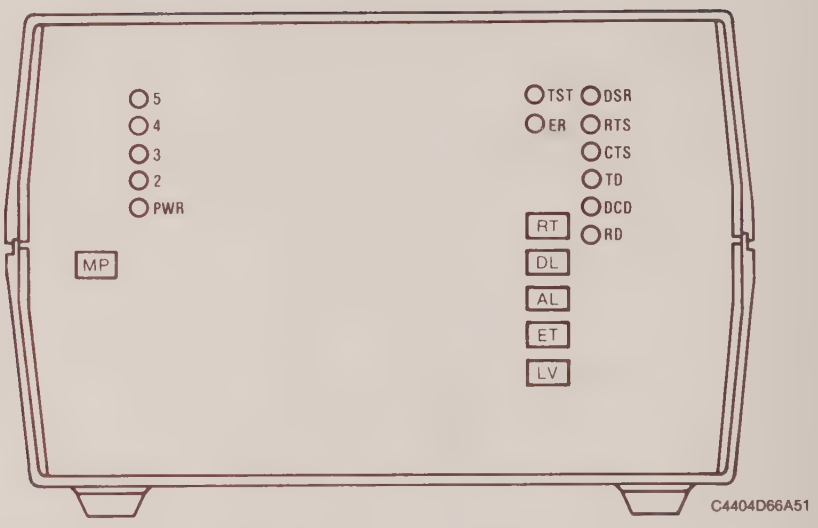



*Figure 1-5: Feature A + M2 and A + M2 + Y4 Modems, Front Panel*

**Dual-Channel** enables the MPS 48 modem at one end of a point-to-point network to accept digital data from two separate terminals; i.e., A and B; multiplex and transmit the data to the MPS 48 modem at the other end. That modem receives the data, demultiplexes it, and delivers it to two other A and B terminals.

Thus, data originated by one A terminal is delivered to the far end A terminal, and data originated by one B terminal is delivered to the far end B terminal. To prevent terminal, or channel, swapping at the receiving modem, the transmitting modem uses phase cogged modulation. This technique is related to the 8 phase (tribit) modulation of the 1800 Hz carrier, normally employed by MPS 48 modems. With phase cogging, every 8 tribits (24 bits) both the transmitter and receiver shift the modulation angle by 22.5 degrees. This provides frame reference signals for the multiplexer and demultiplexer.

The MPS 48 modems at the two ends of the line always transmit and receive a continuous carrier, 4-wire full duplex, at a data speed rate of 4800 bps. With Dual Channel multiplexing, the dual terminals intercommunicate at 2400 bps. If one of the ports of a dual channel MPS 48 is remoted by using a 2400 bps modem, then proper system operation requires a master timing source to synchronize the associated sytem components. Thus, one of the two end MPS 48 modems is assigned to provide master timing; and to operate on its own internal transmit clock. Associated system components operate on external timing which is provided by the master timing modem (refer to NETWORK CONSIDERATIONS, Transmitter Timing Control). Master timing phase shift in the Dual-Channel M2 feature has a clock retiming buffer circuit in its multiplexer. With clock retiming, the buffer allows for a disparity of ± 1 bit between an external transmit clock and the internal modem clock.

Feature A + M2 modems are shipped with Model 96A Splitting Adapter Cable, Part No. 4402-96A, which provides two separate DTE connectors for channels A and B.

**RTS and DCD Simulation** provides the dual terminals at each end of the dual channel network with a pseudo controlled carrier performance which is compatible with the continuous carrier operation of the Dual-Channel feature. When the terminal raises RTS, the M2 + Y4 card transmits a Start of Message (SOM) code which causes the remote M2 + Y4 card to turn on its DCD signal. After sending SOM, the M2 + Y4 card turns on CTS. When the terminal drops RTS, the M2 + Y4 card transmits an End of Message (EOM) code. Reception of this code by the remote M2 + Y4 card causes it to drop DCD. Hence, controlled carrier operation is simulated for a continuous carrier modem.

FEATURE B MODEMS

These modems are supplied with the basic seven PC card complement which uses Transmitter PC Card, Part No. 4404P6609C1. The following special function PC cards can be added to Feature B.

**Feature B + S2** Basic card complement plus Secondary Channel (S2) PC Card, Part No. 4404P6611B (Slot N11). See Figure 1-6.

*Figure 1-6: Feature B + S2 Modem, Front Panel*

**Feature B + T3** Basic card complement plus Remote Multipoint Test (T3) PC Card, Part No. 4404P6611C3 (Slot N11). See Figure 1-7.

**Feature B + T7** Basic card complement plus Multipoint Test and Control (T7) PC Card, Part No. 4404P6611D1 (Slot N11). See Figure 1-7.

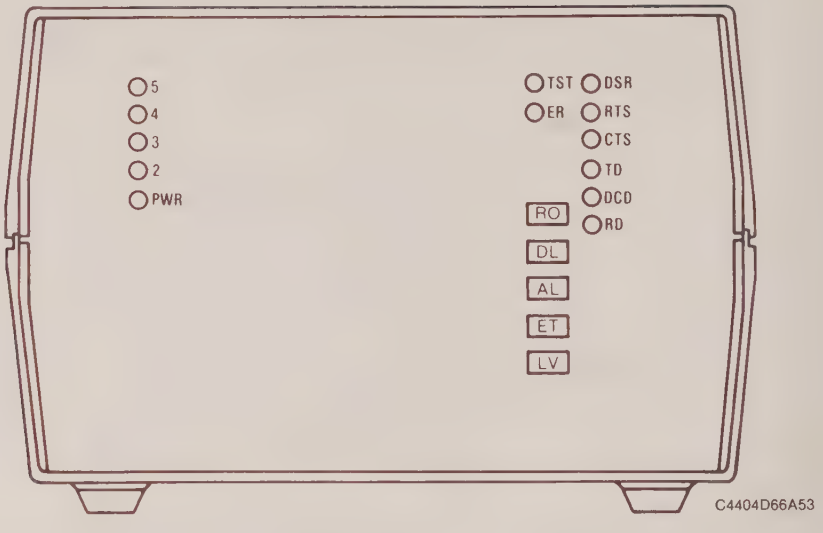



*Figure 1-7: Feature B, B + T3, and B + T7 Modems, Front Panel*

**Secondary Channel** employs FSK modulation for asynchronous data transmission and reception, 4-wire service only, at a data speed rate of up to 150 bps. This feature modem includes Cable Adapter, Part No. 5956K-100U which mates with the J2 (AUX) receptacle and provides a female outlet for the secondary channel. Secondary Channel asynchronous data exchanges operate independently from primary channel synchronous data exchanges.

**Remote Multipoint Test** allows a slave site Modem MPS 48 to recognize its address and command codes from a central site Modem MPS 48 which is equipped with a Model 160 Multipoint Tester. The feature B + T3 PC card has signal reception and demodulation controls only. No transmission control is supplied with this feature.

Upon reception of valid address and command codes, the Feature B + T3 modem is forced into digital or analog loopback test mode; all other slave remote modems in the system, which are not addressed, are disabled from transmission and reception while the central site modem is in the process of remote testing.

**Multipoint Test and Control** enables the modem to operate with System 185 or System 200 Network Diagnostic Controller (NDC). Transceiver circuits in the T7 PC card generate a two-way secondary channel which carries telemetric signal codes to and from System 185 or System 200 NDC at the central site, and the remote sites in an MPS 48 multipoint network.

The telemetric signal codes transferred by the T7 PC card can also control automatic switching of telephone lines (dedicated to dial backup, and vice versa) connected to the modem. This operation is performed by Model 121A Auto Line Adapter (refer to Instruction Manual, Part No. 4404D121A1).

FEATURE C MODEMS

These modems are supplied with the basic seven PC card complement which includes Transmitter PC Card, Part No. 4404P6609C3. These are basic modems intended for 4-wire, Point-to-Point, constant carrier networks. The following special function PC cards can be added to Feature C:

**Feature C + M2** - Requires backplane Part No. 4404P66C (C chassis). The basic card complement uses DTE Interface PC Card, Part No. 4404P6610C-2. Dual-Channel (M2) PC Card, Part No. 4404P6601A1 (Slot N1) is required. See Figure 1-8.

*Figure 1-8: Feature C + M2 Modem, Front Panel*

**Feature C + M2 + Y4 + T7** Requires backplane Part No. 4404P66D (D chassis) and basic card complement which uses DTE Interface PC Card Part No. 4404P6610C-2. Dual-Channel and RTS/DCD Simulation (M2 + Y4) PC Card, Part No. 4404P6601A2; and Multipoint Test and Control (T7) PC Card Part No. 4404P6611D1 are also required. Transmitter PC Card, Part No. 4404P6609C-1 is used in this configuration.

Dual-Channel functions are explained with Feature A + M modem.

FEATURE D MODEM MPS 48 DIAL

This modem is supplied with the basic seven PC card complement which includes Transmitter PC Card, Part No. 4404P6609C1. Special function CBS/CDT PC Card, Part No. 4404P6611A-1 (Slot N11) is installed in Feature D Modem. See Figure 1-9.

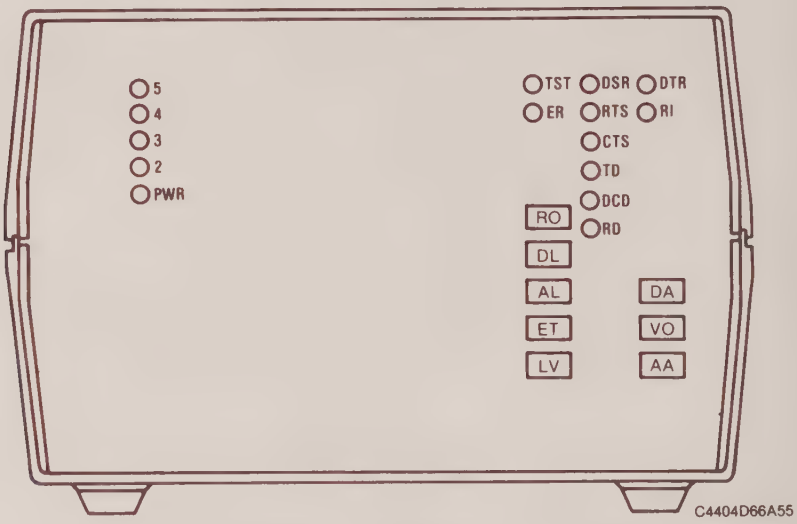



*Figure 1-9: Feature D Modem, Front Panel*

The CBS/CDT Adapter PC card allows the modem to operate on 2-wire dial-up lines terminated with CBS (Automatic) or CDT (Manual) type DAA or RCD couplers. Automatic answer, one-step voice-to-data or data-to-voice switching, or automatic originate with an external Automatic Calling Unit (ACU) require the use of an automatic coupler.

MPS 48 DIAL modems are shipped with cable Part No. 5956-118B-10 which interconnects modem and dial-up coupler. (DT and DR input on TB1 terminals 1 and 2 only.)

MODEM POWER SUPPLY CONFIGURATIONS

Any of the MPS 48 modems listed in Table 1-1 can be equipped with a power supply module which is compatible with one of five different line voltages. A suffix added to the modem part number identifies the selected power supply. Refer to Table 1-2 for a description of part numbers and line voltages selection related to MPS 48 power supplies.

**OPTIONAL EQUIPMENT**

Racal-Milgo offers a variety of optional external equipment to facilitate modem operation and add to its capabilities. This optional equipment is externally mounted, and generally operates with the various modem configurations. Table 1-3 lists the optional equipment currently available, and describes the purposes of the equipment.

All optional equipment connects to the modem at TELSET/AUX receptacle (J2) or the terminal barrier strip (TB1) located on the rear panel of the modem (Figure 1-2).

The Installation and Operation manual provided with each optional equipment device supplies connection and operation instructions. Tables 3-2 and 3-3 describe the pin/signal assignments for the J2 receptacle. Note that, to accommodate signal requirements of D, M2, S2, and T7 features, some J2 pins have two different assignments; in these cases, the corresponding feature is identified in Tables 3-2 and 3-3.

*Table 1-1: Modem MPS 48 Configurations*

| MODEM FEATURE CODE | MODEM PART NO. | SPECIAL FUNCTION PC CARDS REQ'D (P/N) |
|---|---|---|
| A | 4404-66C-14 | 4404P6609C-2 (XMTR)<br>4404P6611C-1 (RMT TEST) |
| A + M2 + Y4 | 4404-66C-24 | 4404P6601A-2 (M2 + Y4)<br>4404P6609C-2 (XMTR)<br>4404P6611C-1 (RMT TEST)<br>4404P6610C-2 (DTE INT) |
| B | 4404-66C-11 | Basic PC Card Complement |
| B + S2 | 4404-66C-13 | 4404P6611B (S2) |
| B + T3 | 4404-66C-15 | 4404P6611C-3 (T3) |
| B + T7 | 4404-66C-18 | 4404P6611D-1 (T7) |
| B + M2 + S2 | 4404-66C-22 | 4404P6601A-1 (M2)<br>4404P6611B (S2)<br>4404P6610C-2 (DTE INT) |
| B + M2 + Y4 | 4404-66C-23 | 4404P6601A-2 (M2 + Y4)<br>4404P6610C-2 (DTE INT) |
| B + M2 + Y4 + S2 | 4404-66C-25 | 4404P6601A-2 (M2 + Y4)<br>4404P6611B (S2)<br>4404P6610C-2 (DTE INT) |
| B + EYE + T7 | 4404-66C-28 | 4404P6611D-1 (T7)<br>Mod. Kit #4404P309A |
| C | 4404-66C-19 | 4404P6609C-3 (XMTR) |
| C + M2 | 4404-66C-26 | 4404P6601A-1 (M2)<br>4404P6609C-3 (XMTR)<br>4404P6610C-2 (DTE INT) |
| D (MPS 48 DIAL) | 4404-66C-12 | 4404P6609C-1 (XMTR)<br>4404P6611A-1 (CBS/CDT) |
| C + M2 + Y4 + T7 | 4404-66D-02 | 4404P6609C-1 (XMTR)<br>4404P6601A-2 (M2 + Y4)<br>4404P6611D-1 (T7)<br>4404P6610C-2 (DTE INT) |

*Table 1-2: Modem MPS 48 Power Supply Configurations*

| MODEM PART NO. SUFFIX | LINE VOLTAGE (NOMINAL) | POWER SUPPLY PART NO. |
|---|---|---|
| 4404-66X - XXU | 115 Vac | 4404-66AD-1 |
| 4404-66X - 1XXU | 100 Vac | 4404-66AD-3 |
| 4404-66X - XXU | 220 Vac | 4404-66AD-2 |
| 4404-66X - 2XXW | 200 Vac | 4404-66AD-4 |
| 4404-66X - 3XXW | 240 Vac | 4404-66AD-5 |

*Table 1-3: Modem MPS 48 Optional Equipment*

| EQUIPMENT | PART NO. | PURPOSE |
|---|---|---|
| Model 16 Voice Adapter | 4402-68A | Provides capability for alternate voice/data communications over 4-wire leased telephone lines. |
| Model 21B Line Adapter | 4404-92A | Provides capability to switch modem between dedicated and dial-up telephone lines without having to readjust modem output and input line levels. |
| Model 121A Auto Line Adapter | 4404-121A | Provides capability to switch modem between dedicated and dial-up telephone lines; also automatic answer in 4-wire networks. Switching can be done manually or automatically. Model 121A operates with System 185 or System 200 NDC and feature T7; this arrangement permits the dial-up connec-tion to be held, and switching between dial and dedicated lines to be tested and verified. |
| Model 23C Multi-Line Adapter | 4402-93C | Provides AC bridge for DDD-PSTN network backup service for multipoint polled system. Requires no changes to hardware or software of the installation. |
| Model 94A Modem Sharing Device | 4402-94A | Provides capability of connecting two to four data terminals to a single modem. Only one DTE uses the modem at a time. |
| Model 188C-2 Adapter | 4402-241B | Provides circuits to convert RS232C interface logic levels to MIL-STD-188C logic levels. Allows modem to be used in military interface applications with no hardware changes. (Connects to J1). |
| Model 61B Auxiliary Controller | 4402-202B | Provides a switch to manually select voice mode or data mode. When the modem operates with a CDT manual Data Access Arrangement, the 61B Controller causes the modem to generate the answer tone when switched from voice to data mode. |
| Model 160 Multipoint Tester | 4405-3 | This tester generates address poll and command codes which are transferred to a central site modem, to force the remote addressed modem into digital or analog loopback test. |
| Splitting Adapter | 4402-96A | This adapter provides separate female outlets for DTE primary channel and secondary channel cable connectors. Connect the Splitting Adapter to receptacle J2 through Racal-Milgo cable Part No. 5956-100C-1, which separates the adapter from the heater sink. This adapter is supplied as part of Feature B + S2. |
| System 185 NDC | 4407-20A | System 185 Network Diagnostic Controller (NDC) is a stand-alone, central site monitoring and fault isolation device for up to 16 data communication networks. The network modems must be equipped with the Multipoint Test and Control, T7 option. |
| System 200 NDC | | System 200 NDC. This system is based on a programmable computer which provides automatic surveillance and fault isolation for up to 64 data communication networks. The network modems must be equipped with the Multipoint Test and Control, T7 option. |

# SECTION 2

# PREINSTALLATION PROCEDURES

## GENERAL INFORMATION

This section contains an analysis of the network environment in which Modem MPS 48 is to be installed. A preinstallation check routine and a list of tools required for the installation are also included in this section.

The typical data communications network is composed of Data Terminal Equipment (DTE), modems, and transmission lines; all correctly matched to operate as a system. Since modems are directly connected to DTE and to transmission lines, each modem is provided with option straps which must be correctly selected to match performance characteristics of associated DTE and transmission lines.

## STRAPPING SELECTIONS

Option straps select such modem operation parameters as transmit signal level, RTS-CTS delay, etc., which are required at the time of installation and which may change from time to time at a particular modem site. Option straps may be removable plastic jumper plugs which connect upright pins at appropriate labelled locations on the modem PC cards; a switchbank with switches which can be set to the desired position; or a soldered jumper which can be removed to suit a specific requirement. Tables 2-1 through 2-11 illustrate the strap locations and describe the strap options.

To gain access to the PC cards, where the strap locations are found, unscrew a top and a bottom captive screw behind the slide-in doors and press on top and bottom of the bezel. Remove the bezel and extract the PC card(s) to be strapped. After strapping, be sure that each PC card is firmly seated on its receptacle at the backplane.

In the basic modem, the following PC cards contain option straps:

(1) Receiver Display PC card, Part No. 4404P6602A (Slot N2), Table 2-1.

(2) Receiver Control PC card, Part No. 4404P6605A-2 (Slot N5), Table 2-2.

(3) Receiver Analog PC card, Part No. 4404P6608B (Slot N8), Table 2-3.

(4) Transmitter PC card, Part No. 4404P6609 (Slot N9), Table 2-4.

(5) DTE Interface PC card, Part No. 4404P6610C-1 (Slot N10), Table 2-5.

The following special function PC cards contain option straps:

(1) Secondary Channel PC card, Part No. 4404P6611B (Slot N11), Table 2-6.

(2) Remote Multipoint Test PC card, Part No. 4404P6611C-3 (Slot N11), Table 2-7.

(3) CBS/CDT Adapter PC card, Part No. 4404P6611A-1 (Slot N11), Table 2-8.

(4) Multipoint Test and Control PC card, Part No. 4404P6611D-1 (Slot N11), Table 2-9.

(5) Dual-Channel PC card, Part No. 4404P6601A1 (Slot N1), Table 2-10.

(6) Dual-Channel and RTS/DCD Simulation PC card, Part No. 4404P6601A2 (Slot N1), Table 2-11. (Dual-Channel requires DTE Interface PC card Part No. 4404P6610C-2.)

## NETWORK CONFIGURATIONS

The manner in which modems are connected to one another through transmission lines determines the network configuration.

### BASIC NETWORKS

There are three basic network configurations: Point-to-Point (Figure 2-1), Multidrop (Figure 2-2), and Multipoint (Figure 2-3). Multipoint is a combination of point-to-point and multidrop. The three basic configurations are also found in more complex link patterns, such as point-to-point with repeater site, multichannel point-to-point, and extended interface networks. For each configuration there are specific characteristics which must be matched at the modem via strap selection.

Transmission lines installed by the telephone company commonly employ VF (voice frequency) bridges to form multidrop connections. VF bridges, shown in Figures 2-2 and 2-3, are line impedance couplers which have one input and, generally, four outputs. A typical 600-ohm impedance appears at both input and output of a VF bridge. All unused bridge outputs must be terminated with a 600-ohm resistor.

Failure to terminate VF bridge unused output or outputs impairs the balanced impedance characteristic of the bridge. As a result, the modems connected to the bridge receive signal reflexions which make the equalizer function difficult to attain.

### POINT-TO-POINT NETWORK WITH REPEATER SITE

Long distance, private line communication between two modem sites can be subject to considerable signal quality degradation and attenuation.

*Figure 2-1: Point-to-Point Network*

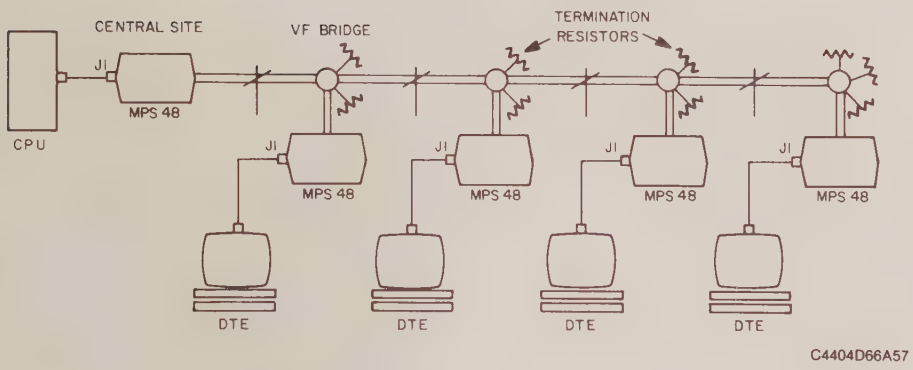



*Figure 2-2: Multidrop Network*

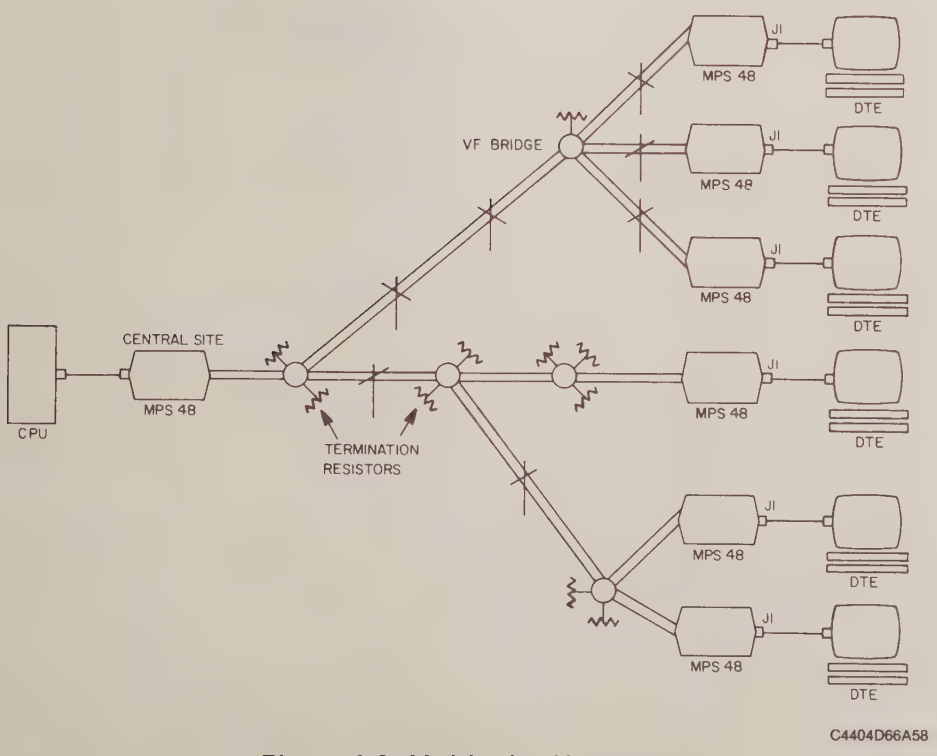



*Figure 2-3: Multipoint Network*

To reduce these conditions, repeater modems are occasionally installed midway between the two end sites.

Figure 2-4 shows a long distance communications link using two Modems MPS 48, connected back-to-back (J1 to J1) as repeater modems. Signal wiring for cable 5956-109A interconnecting the two repeater modems is also shown in Figure 2-4.

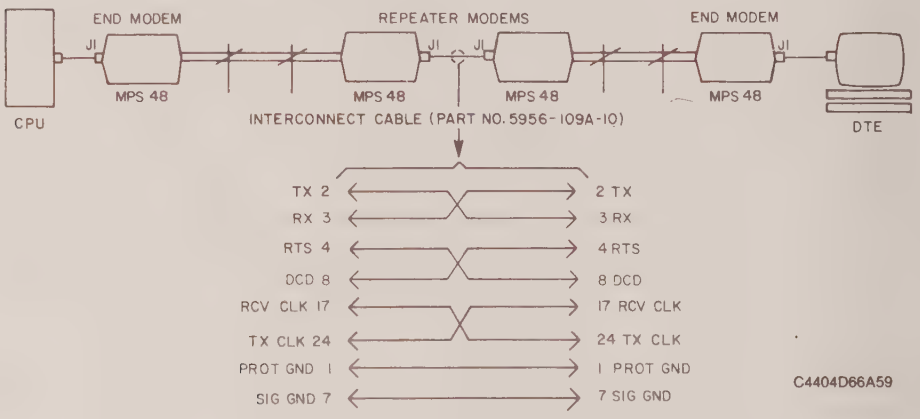



*Figure 2-4: Point-to-Point Network with Repeater Site*

## MULTICHANNEL POINT-TO-POINT AND REMOTE MULTIPOINT NETWORKS

These networks start at the central site of two point-to-point multichannel modems. Figure 2-5 shows two MPS 9601 modems connected over a long distance by private, 4-wire transmission line. The central site MPS 9601 exchanges digital information through two computer ports (A and B), both operating at 4800 bps. The transmission line acts as a "trunk" line, and the remote site MPS 9601 acts as a distribution point where the "trunk" is separated into the original two channels.

The far-end channel A is connected to a remote point-to-point made up of two MPS 48 modems. Channel B is connected to a remote multidrop, also employing MPS 48 modems.

Figure 2-6 shows another typical multichannel point-to-point and remote multipoint arrangement. In this arrangement, two MPS 48 modems with Dual-Channel Feature M2 form the originating point-to-point. The central site MPS 48 exchanges digital data through two computer ports (A and B), both operating at 2400 bps. The remote site MPS 48 separates the signal received into the original channels A and B.

Channel A is directly connected to local terminal equipment, and Channel B becomes the remote/central site of a remote point-to-point data link. This link may employ 24 LSI MARK II or Com-Link III modems.

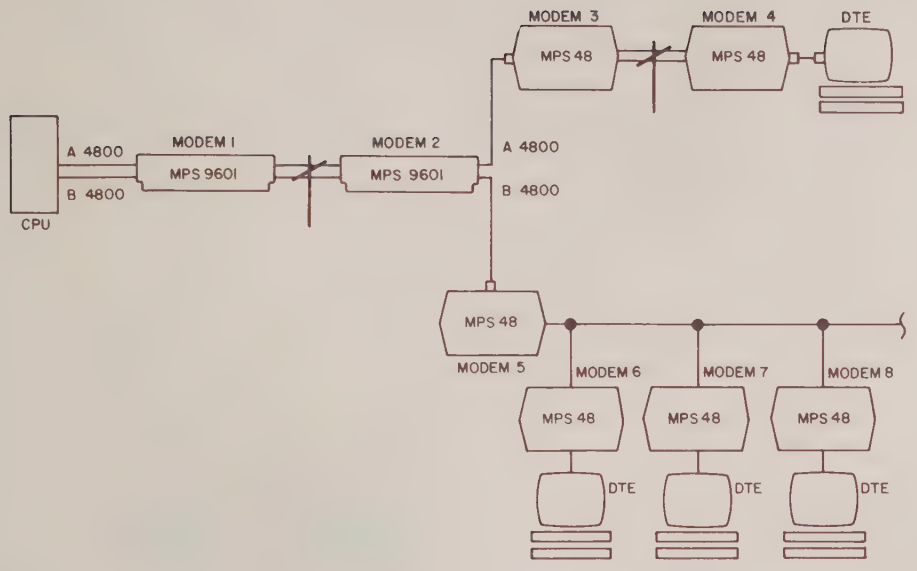



*Figure 2-5: Multichannel MPS 9601 Point-to-Point with Remote Multipoint Network*

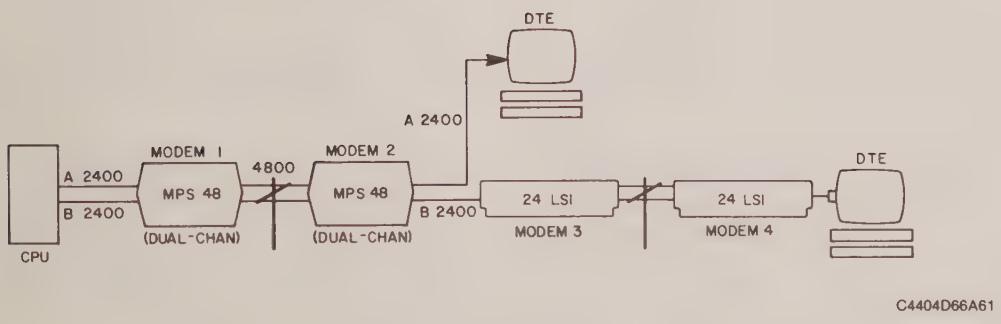



*Figure 2-6: Multichannel MPS 48 Point-to-Point with Remote Multipoint Network*

EXTENDED INTERFACE NETWORK

Extended interface (Figure 2-7) is provided by a short distance, point-to-point configuration of two MPS 48 modems. One of these modems is directly connected to a computer port. The other modem is connected to a console which acts as a distribution center.

In the network of Figure 2-7, the distribution center serves two point-to-point configurations with MPS 48 modems and two directly interfaced DTEs.

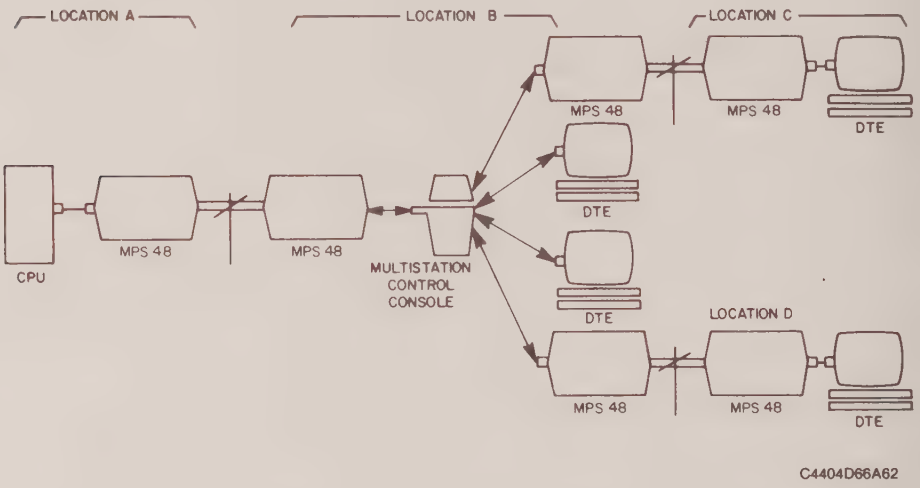



*Figure 2-7: Extended Interface Network*

## NETWORK CONSIDERATIONS

TRANSMITTER TIMING CONTROL

Strap N-1, Internal. This option (Table 2-5) is used at all modems in a point-to-point or multidrop network.

Strap N-2, External, is used in repeater (regenerative) modems (Figure 2-4).

In remoted port applications (Figure 2-8), the central site modem (strapped Internal TX CLK) assumes the master clock function for all modems in the network. The receiver at the remote multichannel derives the master clock signal (RX CLK) and uses it to control data transmission timing. Thus, the central site receives data which is locked to the original master clock signal.

Cable 5956-109A carries the derived master clock signal from the remote multichannel modem to the first remote/central modem; therefore, this modem is strapped at the External Transmit Clock pins.

In modems equipped with Feature T7, use cable 5956-109B instead of cable 5956-109A.

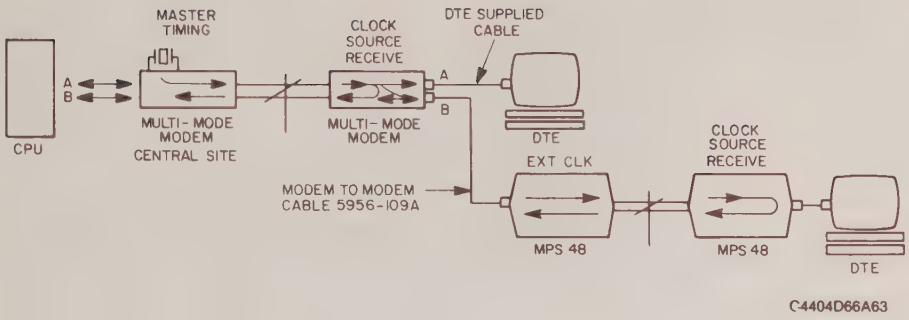



*Figure 2-8: Master Timing Distribution Network*

The farthest remote/remote modems in the extended interface network receive data locked to the original master clock signal, derive this signal (RX clock) and use it to time control their data transmission. Thus, timing in the remote/remote modems is also locked to the central site master clock timing control.

## CARRIER CONTROL

Straps S and R. The setting of these straps (Table 2-5) allows the modem transmitter to generate the modulated carrier either continuously, or switched only while the terminal equipment raises the RTS signal.

Continuous or switched (also called controlled) carrier operation depends on network requirements.

**Example A:** In a point-to-point, half duplex network, both end-modems must be set to switched carrier. These settings allow half-duplex data traffic control; first in one direction, then in the opposite direction.

**Example B:** In a point-to-point, full duplex network, both end-modems may be set for continuous carrier. These settings allow the simultaneous, two-way data traffic of full duplex.

**Example C:** In a multidrop or multipoint, full duplex network, it is customary to set the central site modem for continuous carrier and the remote site modems for switched carrier. These settings allow each remote site modem to "talk back" to the central site modem.

When possible, continuous carrier operation is advisable because it results in greater data throughput. The on-off condition of a controlled carrier reduces throughput due to the turn-around delay from transmission to reception.

RTS-CTS DELAY

Strap S and R. In a network using repeater (regenerative) modems (Figure 2-4), strap the outer end-modems for 65 ms RTS-CTS delay; strap the repeater modems for 26 ms RTS-CTS delay. In a multipoint network, or point-to-point network with no repeater modems, (Figures 2-1 and 2-3), strap all modems for 26 ms RTS-CTS delay.

In a MPS 48 modem strapped for continuous carrier operation, even though the carrier is constantly transmitted, RTS and CTS occasionally drop. When RTS raises, the RTS-CTS delay for which the modem has been strapped prevails.

The short RTS-CTS delay (26 ms) results in higher throughput. However, the longer RTS-CTS delay (65 ms) may be used as a fallback emergency setting in case of data transfer errors due to an incorrectly equalized telephone line.

It is possible to strap the modem at one end for short RTS-CTS delay and the modem at the other end for long RTS-CTS delay. After 26 ms, the remainder of the RTS-CTS delay, if any, is scrambled 1's.

ECHO PROTECTION IN 2-WIRE OPERATION

Straps V and W. These two straps are used in 2-wire networks where excessive echo effects are encountered. In the "turn around" period from transmit to receive or receive to transmit, the V strap is used to disable the modem receiver for up to 80 ms, after RTS drops at the end of transmission. The W strap inhibits internal RTS (IRTS) for up to 125 ms after DCD drops at the end of reception.

Thus, at one end (modem A) the V strap setting prevents the line echo from entering the receiver, causing a false DCD, and the associated DTE to interpret its own transmission.

At the other end (modem B) the W strap setting delays the start of transmission sequence until modem A has enabled its receiver.

Excessive line echo effects are most commonly encountered on FX and tie lines. In such cases, modems at the two ends of the line should have the same V and W strap setting; for example, V-3 and W-3.

The W strap function is automatically disabled by the circuits in 4-wire operation.

EQUALIZER CONTROL

Straps A and B. The Receive Analog PC card (Table 2-3) equalizer has phase and amplitude compensation for receive signal distortion. The modem is shipped with factory set single delay and amplifier (A-2 and B-1 straps) compensation; however, other equalizer settings may be used in cases of highly distorted lines.

## TRANSMISSION LINE CONSIDERATIONS

**TRANSMIT LEVEL**

Straps E and F. Transmit carrier level must be set to telephone company requirements. See Table 2-4.

In USA, 0dBm is typical modem setting for leased (private) line service and −8dBm modem setting for DDD-PSTN (dial-up) line service. In Europe, −4dBM is typical modem setting for leased line service and 0dBm modem setting for DDD-PSTN line service. Consult the telephone company.

The modem transmit level (MTL) is the maximum carrier level allowed by the telephone company. However, the modem may be strap set to a lower level, particularly to compensate for different line distances to the central site in multipoint networks.

**RECEIVE LEVEL RANGES**

Strap H. Set this strap to conform with the transmission line (Table 2-4). For private (dedicated) lines, select strap H-1; for normal dial-up lines, strap H-2.

**RCC DELAY**

Strap V. The Receiver Carrier Control is a delay period provided in half-duplex (controlled carrier) operation at the time of switching from transmission to reception.

During the RCC delay, echo reflexed transmission signals are squelched to prevent their re-entry into the modem receiver.

One of three RCC delays can be selected: a normal 17 ms (strap V-1) delay, a medium 40 ms delay (strap V-2) or a long 80 ms (strap V-3) delay. A longer RCC delay may reduce errors in dial-up and 2-wire multipoint installations.

In full duplex, 4-wire operation the RCC delay is disabled.

**ANALOG LOOPBACK GAIN CONTROL**

Strap C. The transmission line analog loopback (AL) is meaningful only in 4-wire operation where the receive pair can be connected to the send pair. Therefore, in 2-wire operation, the AL is always disabled by strap C-1. (Table 2-4).

In 4-wire installations, the modem forms AL by connecting receive pair and send pair. If no signal gain in the loop is desired, set the strap at C-2. For a stage of +10dB signal gain inserted into the loopback, set the strap at C-3. Consult the telephone company to determine the selection of C-2 or C-3 strap.

The AL disable strap C-1 may also be used in certain 4-wire installations where analog loopback is not desired.

## DTE CONSIDERATIONS

**TRANSMITTER TIMING**

Strap N. The setting of this strap determines the source of timing control to be used for modem transmission (Table 2-5).

With Strap N-1, Internal, the modem uses its own clock signal to time control the modem transmitter and (through J1-15) to synchronize DTE operation.

With Strap N-2, External, modem transmitter, timing is supplied (through J1-24) by the DTE or some other source of master timing control.

With Strap N-3, RX Clock, the receive derived timing (clock source receive) is used to time control modem transmitter. Strap N-3 is selected in remoted port applications where the central site modem assumes the master clock function for the entire network (See Figure 2-7).

**BIT RATE**

Strap RR. Select bit rate, 4800 bps or any other bit rate, in accordance with customer terminal equipment requirements. Modems at both ends of the data exchange must be set to the same bit rate.

**RECEIVE CLOCK CONTROL**

Strap G. This strap fulfills a DTE requirement: the DTE may request that the Receiver Signal Element Timing provided by the modem be continuously present at J1-17; in this case, strap the modem at G-1. Otherwise, the DTE may request that the Receiver Signal Element Timing be made available at J1-17 only when the DCD signal is present; in this case, strap the modem at G-2.

**NEW SYNC**

Strap A. The New Sync signal (Table 2-5) is applicable to a central site modem which polls numerous remote site modems. Without New Sync, the DCD signal (J1-8) which is normally delayed by the modem after the carrier drops (dead time), prevents DTE fast switching from one remote site to the next.

The DTE generates the New Sync signal when it detects ETX (End of Text) or EOM (End of Message) during a block transmission. Immediately upon receipt of New Sync the modem drops DCD, resynchronizes with the new carrier and again raises the corresponding DCD signal to the DTE.

**TX BAUD**

Strap T. The TX Baud is a signal provided to the DTE (via J2-2) at the Baud rate (Table 2-5). This signal is required by certain data processors.

**DTE COMPATIBILITY**

Modem MPS 48 requires that the Data Terminal Equipment (DTE) conform to the following requirements:

(1) DTE must have standard EIA-RS232C or CCITT V.24 Interface capability. No adapter is available for DTEs operating on different interface standards.

(2) Synchronous DTE exchanges only through the primary channel. Modem MPS 48 accepts asynchronous data exchanges through the secondary channel at 150 bps maximum.

(3) Modem MPS 48 operates on internal clock, or external clock which meets modem specifications.

**EQUIPMENT GROUND**

For operator's safety and the correct operation of the equipment, it is recommended that circuit ground and chassis (frame) ground be joined at one designated common point in the equipment.

MPS 48 joins circuit and chassis grounds from the DTE and the modem with the saddle jumper installed between TB1 terminals 5 and 6 (Figure 1-2). The DTE ground lines are transferred to the modem through the DTE interface cable (J1-1 and J1-7).

The saddle jumper should be removed only when a different common ground is designated. This action is usually due to "ground circuit loops" which may cause excessive signal noise.

**PREINSTALLATION CHECKS**

Before modem installation, perform the following checks:

(1) Ensure that DTE interface cable does not exceed 50 feet (15.2 meters) and that physical location of modem allows connection of cable to data terminal equipment.

(2) Check cable lengths of rack mounted modems to ensure that the modem can be connected without stressing DTE, transmission line, or ac power cables.

(3) Make every effort to see that DTE and modem are plugged into ac power outlets which are connected to the same ground line. The DTE/modem system may be subject to "noise" interference when separate ac or ground sources are used.

(4) Check that modem is installed within 10 feet (3 meters) of a grounding type ac power outlet.

(5) Ensure that the modem will fit well in the selected location. Unit must be physically stable and protected from corrosive spray or atmosphere.

(6) Check that voltage at ac power outlet is the same as that for which the modem is set to operate; refer to SYSTEM CONNECTIONS, AC Power Source.

(7) Check that transmission lines have been installed for the modem.

**TOOLS REQUIRED**

The basic tools required for modem installation are as follows:

Pliers

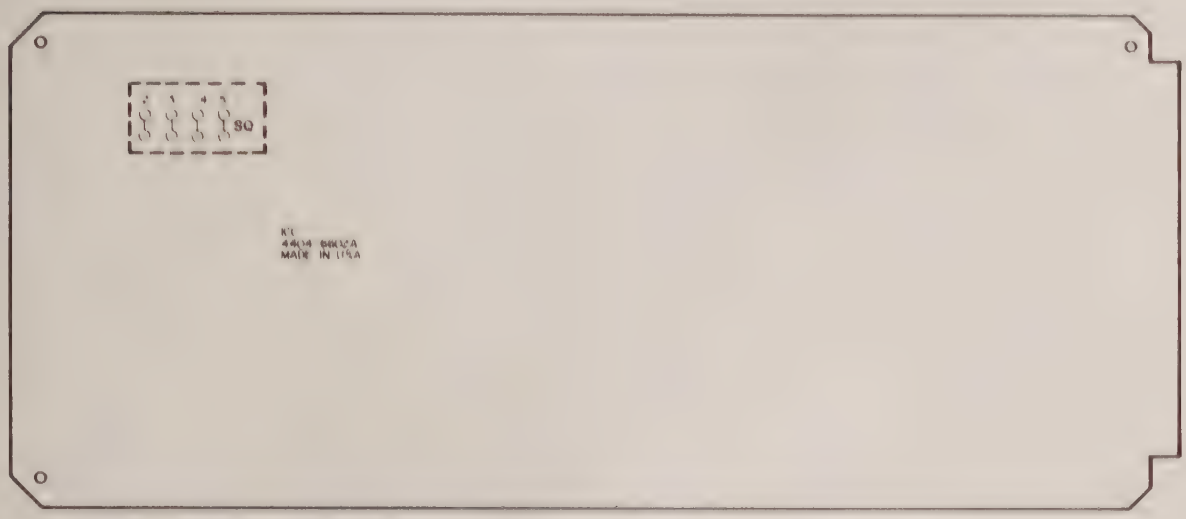
Wire Stripper

Screwdriver

Nutdriver

AC Line Tester

*Table 2-1: Receiver Display PC Card, Strap Options*




RECEIVER DISPLAY PC CARD, PART NO. 4404P6602 (SLOT N2)

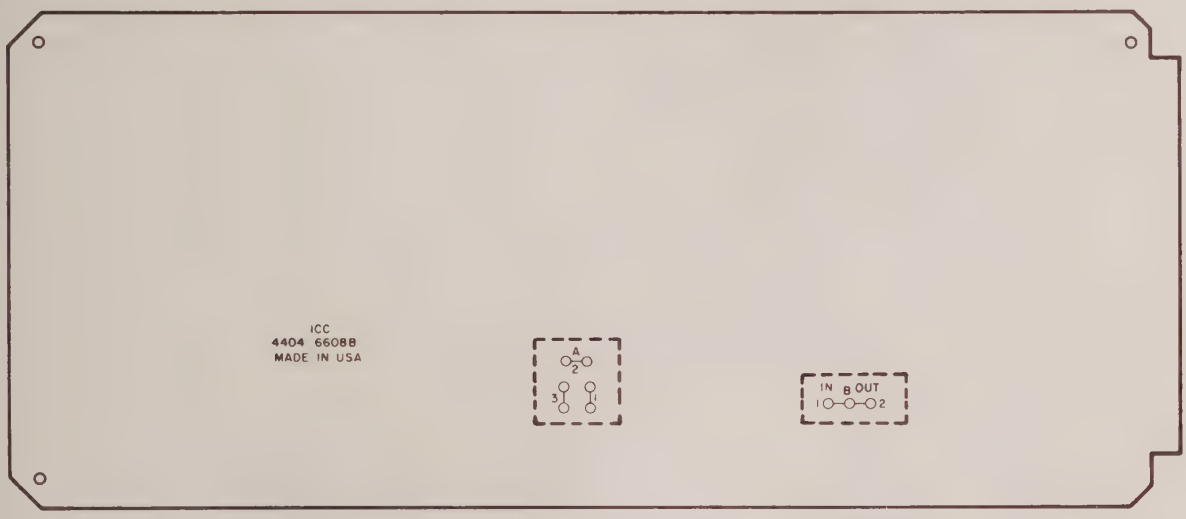
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Signal Quality Indication Selection | Indicator 5 | 2 3 4 5<br>o o o [o]<br>o o o [o] SQ | Signal quality at J1-21, as indicated by display lamp 5. |
| | Indicator 4 | 2 3 4 5<br>o o [o] o<br>o o [o] o SQ | Signal quality at J1-21, as indicated by display lamp 4. |
| | Indicator 3 | 2 3 4 5<br>o [o] o o<br>o [o] o o SQ | Signal quality at J1-21, as indicated by display lamp 3. |
| | Indicator 2 | 2 3 4 5<br>[o] o o o<br>[o] o o o SQ | Signal quality at J1-21, as indicated by display lamp 2. |

*Table 2-2: Receiver Control PC Card, Strap Options*

RECEIVER CONTROL PC CARD, PART NO. 4404P6605A (SLOT N5)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Multiport Frame (MF) Receive Selection | No MF Receive | 2 M 1 | No Multiport Frame is present on received line signal. |
| | MF Receive | 2 M 1 | Multiport Frame is present on received line signal. |

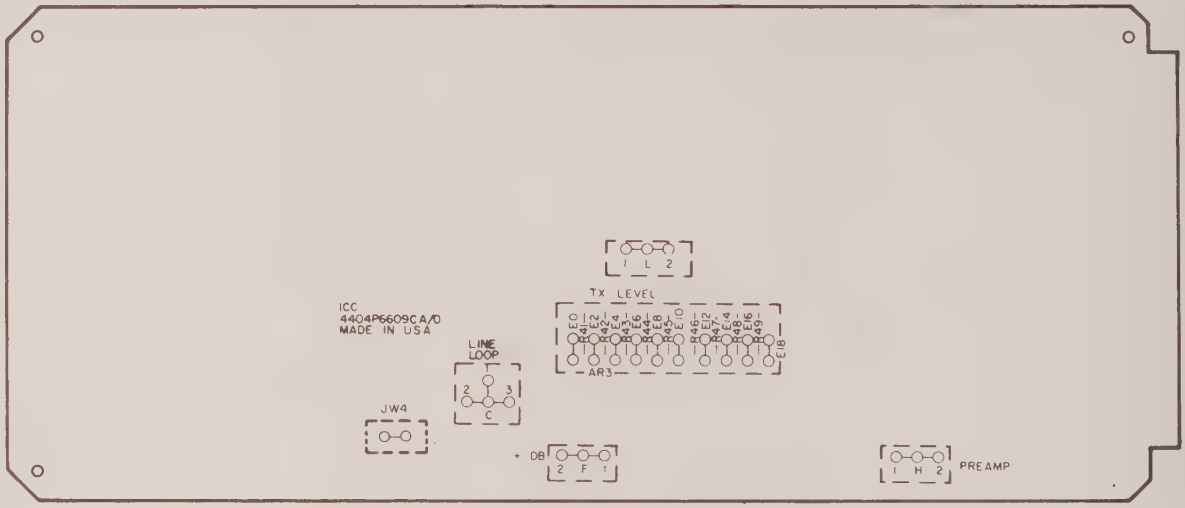
*Table 2-3: Receiver Analog PC Card, Strap Options*




RECEIVER ANALOG PC CARD, PART NO. 4404P6608B (SLOT N8)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Equalizer | No Delay | A<br>○ ○<br>2<br>3 ○ ▯ 1<br>○ ○ | Equalizer delay is out. |
| | Single Delay | A<br>▯<br>2<br>3 ○ ○ 1<br>○ ○ | One delay section is in. |
| | Double Delay | A<br>○ ○<br>3 ▯ ○ 1<br>○ ○ | Two delay sections are in. |
| Equalizer Amplifier Selection | Amplifier | B<br>1 ▯ ○ 2<br>(F) | Amplitude equalizer is connected. |
| | No Amplifier | B<br>1 ○ ▯ 2 | Amplitude equalizer is disconnected. |

*Table 2-4: Transmitter PC Card, Strap Options*




TRANSMITTER PC CARD, PART NO. 4404P6609C (SLOT N9)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Telephone Line Analog Loopback Control Selection | No Loopback | 1 / 2 ○ ○ 3 / C | No AL test in 4-wire service. |
| | 0dBm Gain Loopback | 1 / 2 ○ ○ 3 / C | AL test with 0dBm gain in 4-wire service. |
| | +10dBm Gain Loopback | 1 / 2 ○ ○ 3 / C | AL test with +10dBm gain in 4-wire service.<br><br>Analog Loopback line test is meaningless in 2-wire service. |

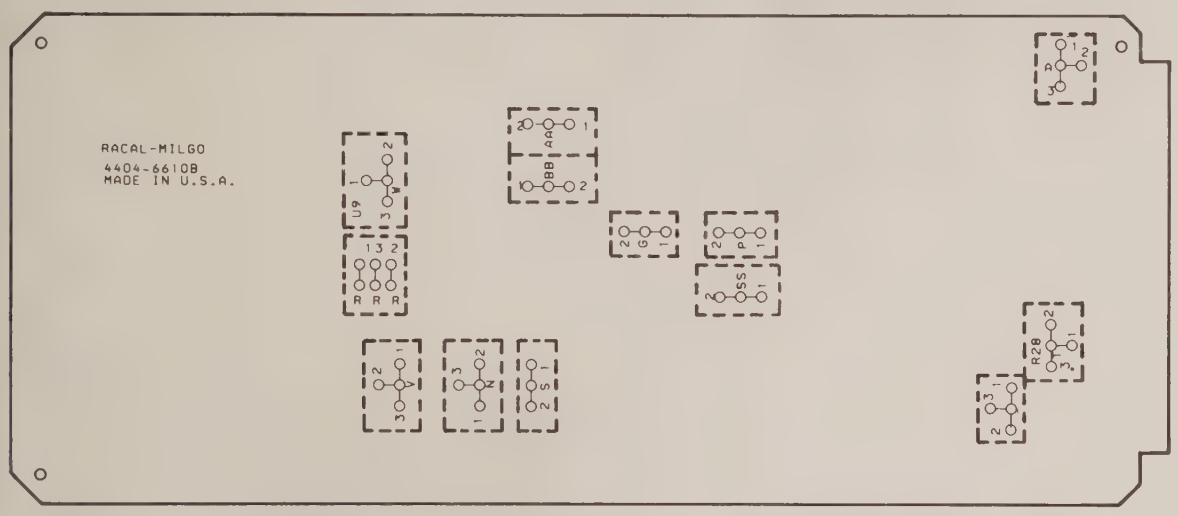
*Table 2-4: Transmitter PC Card, Strap Options (continued)*

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Transmit Level Selection | E - 0<br>E - 2<br>E - 4<br>E - 8<br>E - 10<br>E - 12<br>E - 14<br>E - 16<br>E - 18 | E0 E2 E4 E6 E8 E10 E12 E14 E16 E18<br>o o o o o o o o o o<br>o o o o o o o o o o<br>o o o<br>2 F 1 | The combination of E and F strap positions provides the desired transmit level, as follows:<br><br>E-0 and F-2 = +1dBm<br>E-0 and F-1 = 0dBm<br>E-2 and F-2 = −1dBm<br>E-2 and F-1 = −2dBm<br>E-4 and F-2 = −3dBm<br>E-4 and F-1 = −4dBm<br>E-6 and F-2 = −5dBm<br>E-6 and F-1 = −6dBm<br>E-8 and F-2 = −7dBm<br>E-8 and F-1 = −8dBm<br>E-10 and F-2 = −9dBm<br>E-10 and F-1 = −10dBm<br>E-12 and F-2 = −11dBm<br>E-12 and F-1 = −12dBm<br>E-14 and F-2 = −13dBm<br>E-14 and F-1 = −14dBm<br>E-16 and F-2 = −15dBm<br>E-16 and F-1 = −16dBm<br>E-18 and F-2 = −17dBm<br>E-18 and F-1 = −18dBm<br><br>Transmit carrier level must be set to telephone company requirements.<br><br>In USA, 0dBm is typical setting for leased (private) line service and −8dBm setting for DDD-PSTN (dial-up) line service. |
| | F - 1<br>F - 2 | | |

*Table 2-4: Transmitter PC Card, Strap Options (continued)*

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Receive Range Selection | 0 to −30dBm | 1 H 2 | Receive range is 0dBm to −30 dBm. DCD pull-in occurs at −27dBm. Applicable to private line service. |
| | −16 to −46dBm | 1 H 2 | Receive range is −16dBm to −46dBm. DCd pull-in occurs at −43dBm. Applicable to dial-up service. |
| Multiport Frame (MF) Transmit Selection | No MF Transmit | 1 L 2 | No Multiport Frame is present on transmit line signal. |
| | MF Transmit | 1 L 2 | Multiport Frame is present on transmit line signal. |
| Model 160 MT Enable | Connect | JW4 | Use JW4 soldered jumper to enable Feature B+T3 operation with Model 160 Multipoint Tester. |
| | Disconnect | JW4 | Remove JW4 jumper when Model 160 MT is not required. |
| AL and DL Remote Test Requirement | | JW4 | To conduct AL or DL Remote Test, jumper JW4 must be in. |

*Table 2-5: DTE Interface PC Card, Strap Options*




DTE INTERFACE PC CARD, PART NO. 4404-6610C (SLOT N10)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| New Sync Selection | No New Sync | A 1 2 3 | New Sync is not used. |
| | New Sync at J1-11 | A 1 2 3 | New Sync signal appearing at J1-11 is used. |
| | New Sync at J1-14 | A 1 2 3 | New Sync signal appearing at J1-14 is used. |
| Receiver Timing Selection at J1-17 | Continuous | 2 G 1 | Receiver timing is always present at J1-17. |
| | DCD off Inhibit | 2 G 1 | Receiver timing at J1-17 is forced to + V when DCD is off. |
| Transmitted Timing Control Selection | Internal | 3 2 N 1 | Modem transmitter supplies its own timing. |
| | External | 3 2 N 1 | Modem transmitter accepts external timing from J1-24. In a Master Timing Distribution Network, cable 5956-109A is used to connect RX CLK from a remote point-to-point modem to the TX CLK of an extended network modem (Figure 2-8). |

*Table 2-5: DTE Interface PC Card, Strap Options (continued)*

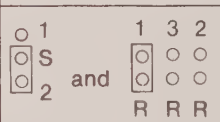
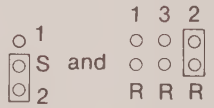
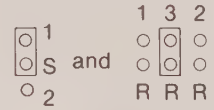
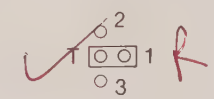
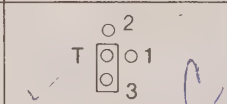
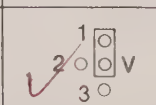
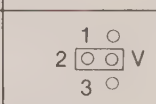
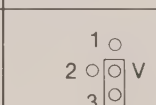
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Transmitted Timing Control Selection (Continued) | Internal Receiver | | Modem transmitter supplies timing derived from receiver timing; 4-wire service only. |
| 4-Wire/2-Wire Selection | 4-Wire | | Four-Wire operation. |
| | 2-Wire | | Two-Wire operation. Allows control through J2-16. |
| Carrier Control and RTS-CTS Delay Selection | 0 ms |   | Continuous carrier in 4-Wire only. No RTS-CTS delay. Strap S-2 and R-1. |
| | 20 ms |   | Continuous carrier in 4-Wire only. RTS-CTS delay 20 ms. Strap S-2 and R-2. |
| | 26 ms | | Switched carrier. RTS-CTS delay 26 ms. Strap S-1 and R-1. |
| | 65 ms |   | Continuous or switched carrier. RTS-CTS delay 65 ms. Strap S-1 and R-3. |
| Terminal J2-2 Signal Selection | TX Baud Clock |   | TX Baud signal appears at J2-2. |
| | – V | | Test – 12Vdc source appears at J2-2. |
| | Sec. Chan. RX Data |   | Secondary Channel receive data appears at J2-2. |
| RCC Delay Selection (Two-Wire Only) | 17 ms |   | RCC/SCC delay is 17 ms (standard). |
| | 40 ms |   | RCC/SCC delay is 40 ms. Use for echo protection in 2-wire. |
| | 80 ms |   | RCC/SCC delay is 80 ms. Use for echo protection in 2-wire. |

*Table 2-5: DTE Interface PC Card, Strap Options (continued)*

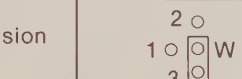
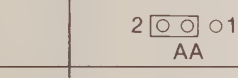
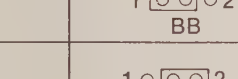
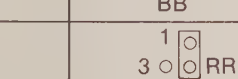
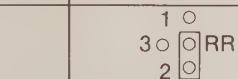
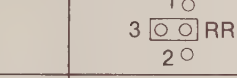
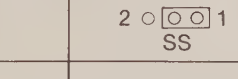
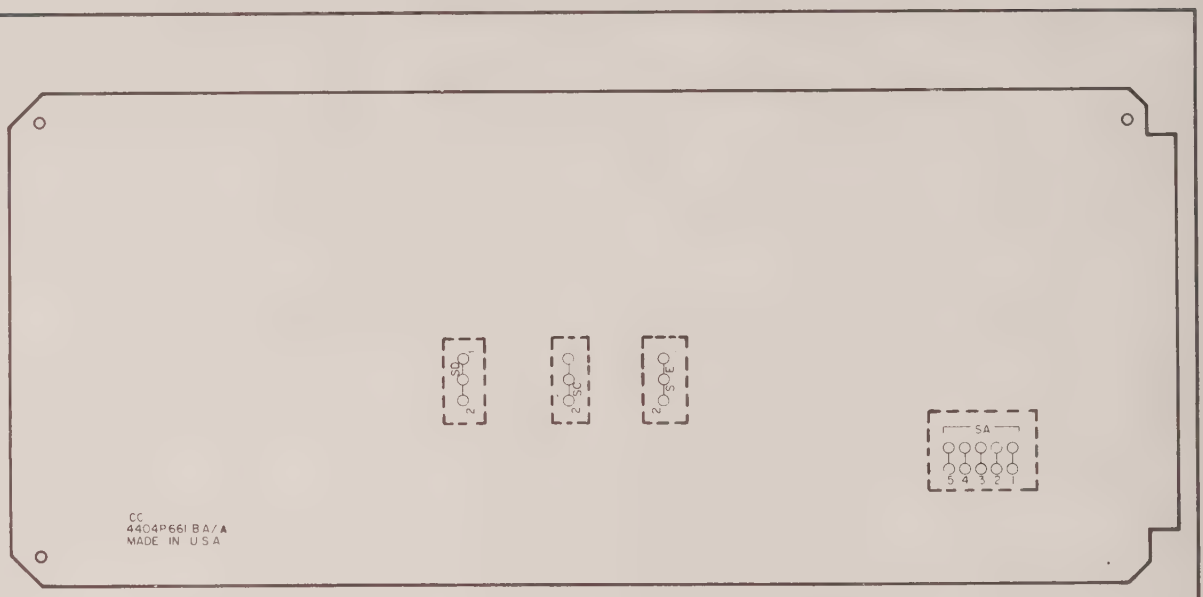
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| RTS-CTS Delay Extension for Echo Protection in Two-Wire | 0 ms Extension | | In 2-wire, RTS-CTS delay is 26 ms (standard). |
| | 33 ms Extension | | In 2-wire, RTS-CTS delay is 58 ms. |
| | 100 ms Extension |   | In 2-wire, RTS-CTS is 125 ms. |
| AL Test, DSR Control Selection | Inhibit DSR | | AL test forces DSR off. |
| | Allow DSR |   | AL test allows DSR to stay on. |
| DL Test, DSR Control Selection | Inhibit DSR |   | DL test forces DSR off. |
| | Allow DSR |   | DL test allows DSR to stay on. |
| Data Speed Rate Control Selection | 4800 bps |   | Modem operates at 4800 bps. |
| | 3200 bps |   | Modem operates at 3200 bps. |
| | External Control |   | Modem operates at data speed present at J1-23. |
| Two-Wire Echo Control Selection | Normal Line Performance | | Use SS-1 when transmission lines present no echo effects. |
| | Echo Control |   | Use SS-2 when transmission lines are affected by echo problems. |

*Table 2-6: Feature S2, Secondary Channel PC Card, Strap Options*



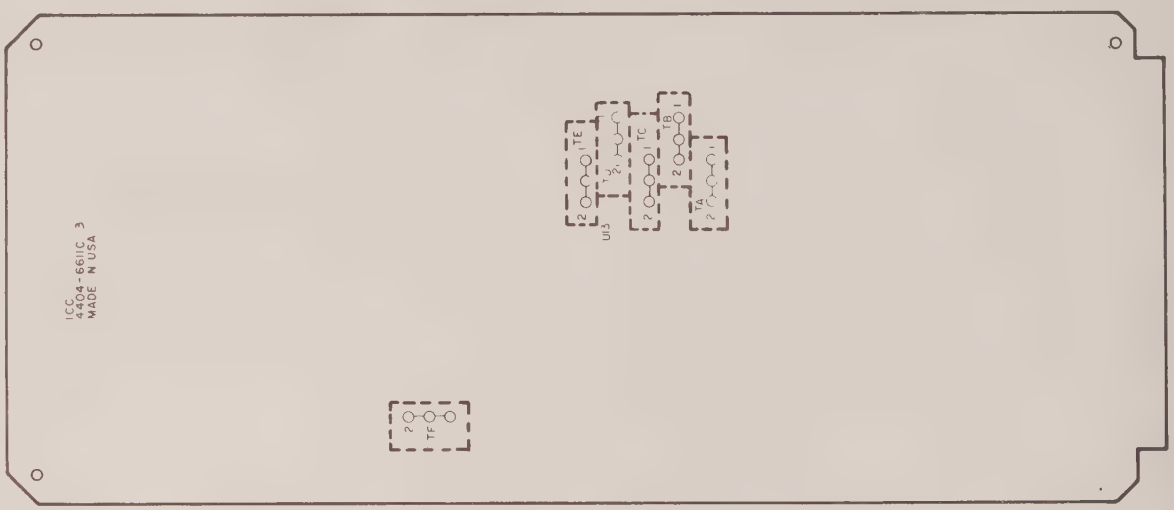

FEATURE S2, SECONDARY CHANNEL PC CARD, PART NO. 4404P6611B (SLOT N11)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Transmission Control Selection | DTE Controlled | SA 5 4 3 2 1 | Secondary Channel transmission is under DTE control (J1-19). |
| | With RTS Off | SA 5 4 3 2 1 | Secondary Channel transmission occurs when primary channel RTS is off. |
| | With RTS On | SA 5 4 3 2 1 | Secondary Channel transmission occurs when primary channel RTS is on. |
| | Continuous | SA 5 4 3 2 1 | Secondary Channel transmission is continuous. |
| | Inhibited | SA 5 4 3 2 1 | Secondary Channel transmission is inhibited. |
| MARK/SPACE Tone Freq. Selection | Normal | 1 SC 2 and 1 SD 2 | MARK = 390 Hz SPACE = 450 Hz SC-1 and SD-1 |
| | Reversed | 1 SC 2 and 1 SD 2 | MARK = 450 Hz SPACE = 390 Hz SC-2 and SD-2 |

*Table 2-6: Feature S2, Secondary Channel PC Card, Strap Options (continued)*

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Additional Strap Selections | Transmit Data Source | [1] SE 2 | Secondary Channel transmit data is taken from J1-14. |
| | Mark Hold On Sec. CTS Off | 1 [SE] 2 | Only Mark Hold is sent; Secondary Channel CTS is clamped off. |

*Table 2-7: Feature T3, Remote Multipoint Test PC Card, Strap Options*




FEATURE T3, REMOTE MULTIPOINT TEST PC CARD, PART NO. 4404P6611C-3 (SLOT N11)

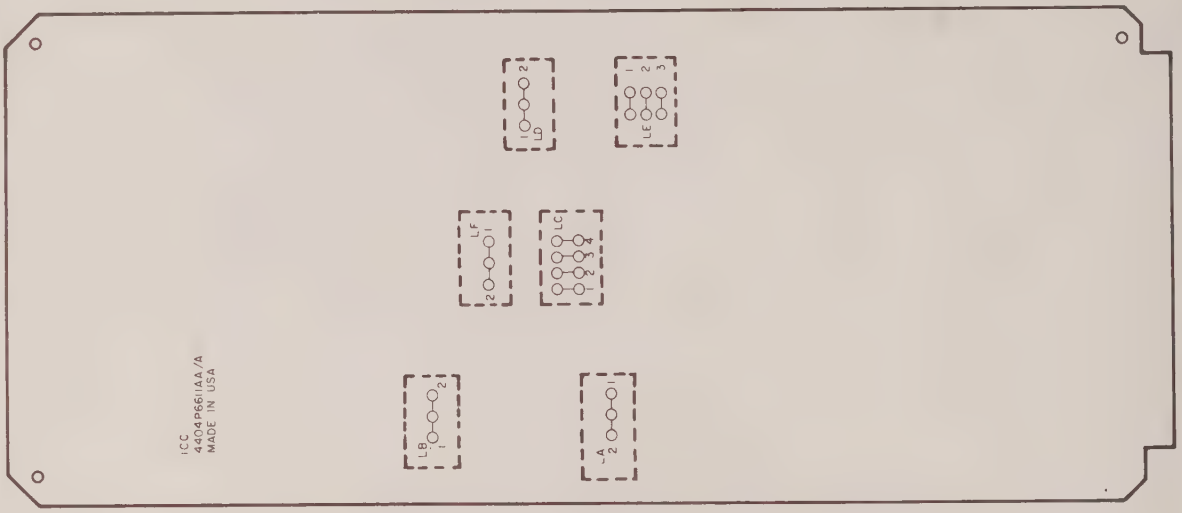
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Anti-Streaming Timer Selection | Timer Out | 2 TF 1 | 30-second anti-streaming timer is disabled. |
| | Timer In | 2 TF 1 | 30-second anti-streaming timer is enabled. |
| Address Assignment | TA-1<br>TA-2<br>TB-1<br>TB-2<br><br>TC-1<br>TC-2<br>TD-1<br>TD-2<br>TE-1<br>TE-2 | TE 1 2 TD 1 2 TC 1 2 TB 1 2 TA 1 2 | The assigned site address is encoded in a remote modem with a combination (binary arrangement) of straps TA, TB, TC, TD and TE. The combinations and their corresponding addresses are as follows: |

| STRAP POSITIONS | ADDRESS CODE |
|---|---|
| TA-2, TB-2, TC-2, TD-2, and TE-1 = | 1 |
| TA-2, TB-2, TC-2, TD-1, and TE-2 = | 2 |
| TA-2, TB-2, TC-2, TD-1, and TE-1 = | 3 |
| TA-2, TB-2, TC-1, TD-2, and TE-2 = | 4 |
| TA-2, TB-2, TC-1, TD-2, and TE-1 = | 5 |
| TA-2, TB-2, TC-1, TD-1, and TE-2 = | 6 |

*Table 2-7: Feature T3, Remote Multipoint Test PC Card, Strap Options (continued)*

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Address Assignment (Continued) | | TA-2, TB-2, TC-1, TD-1, and TE-1 = | 7 |
| | | TA-2, TB-1, TC-2, TD-2, and TE-2 = | 8 |
| | | TA-2, TB-1, TC-2, TD-2, and TE-1 = | 9 |
| | | TA-2, TB-1, TC-2, TD-1, and TE-2 = | 10 |
| | | TA-2, TB-1, TC-2, TD-1, and TE-1 = | 11 |
| | | TA-2, TB-1, TC-1, TD-2, and TE-2 = | 12 |
| | | TA-2, TB-1, TC-1, TD-2, and TE-1 = | 13 |
| | | TA-2, TB-1, TC-1, TD-1, and TE-2 = | 14 |
| | | TA-2, TB-1, TC-1, TD-1, and TE-1 = | 15 |
| | | TA-1, TB-2, TC-2, TD-2, and TE-2 = | 16 |
| | | TA-1, TB-2, TC-2, TD-2, and TE-1 = | 17 |
| | | TA-1, TB-2, TC-2, TD-1, and TE-2 = | 18 |
| | | TA-1, TB-2, TC-2, TD-1, and TE-1 = | 19 |
| | | TA-1, TB-2, TC-1, TD-2, and TE-2 = | 20 |
| | | TA-1, TB-2, TC-1, TD-2, and TE-1 = | 21 |
| | | TA-1, TB-2, TC-1, TD-1, and TE-2 = | 22 |
| | | TA-1, TB-2, TC-1, TD-1, and TE-1 = | 23 |
| | | TA-1, TB-1, TC-2, TD-2, and TE-2 = | 24 |
| | | TA-1, TB-1, TC-2, TD-2, and TE-1 = | 25 |
| | | TA-1, TB-1, TC-2, TD-1, and TE-2 = | 26 |
| | | TA-1, TB-1, TC-2, TD-1, and TE-1 = | 27 |
| | | TA-1, TB-1, TC-1, TD-2, and TE-2 = | 28 |
| | | TA-1, TB-1, TC-1, TD-2, and TE-1 = | 29 |
| | | TA-1, TB-1, TC-1, TD-1, and TE-2 = | 30 |
| | | TA-1, TB-1, TC-1, TD-1, and TE-1 = | 31 |

*Table 2-8: Feature D, CBS/CDT Adapter PC Card, Strap Options*




FEATURE D, CBS/CDT ADAPTER PC CARD, PART NO. 4404P6611A (SLOT N11)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| DTR Control Selection | Normal | 1<br>LA<br>2 | DTR operates normally. |
| | Internal Control | 1<br>LA<br>2 | DTR is held on internally. |
| Y-Option (LCSI) Enable Disable Selection | Disable | 2<br>LB<br>1 | Y-Option is disabled. |
| | Enable | 2<br>LB<br>1 | Y-Option is enabled. |
| Auto/ Manual Coupler Selection | Auto No ACU | LC 4 3 2 1 and LF 1 2 | Strap LC-1 and LF-1 for automatic coupler (RCD or DAA), without Automatic Calling Unit (ACU). |

*Table 2-8: Feature D, CBS/CDT Adapter PC Card, Strap Options (continued)*

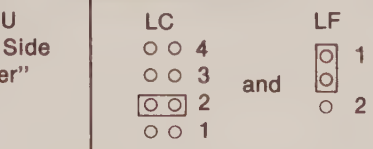
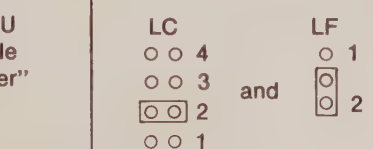
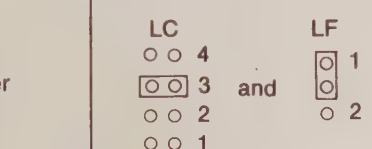
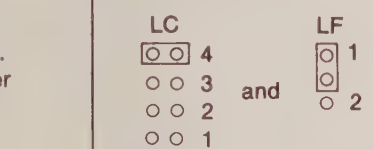
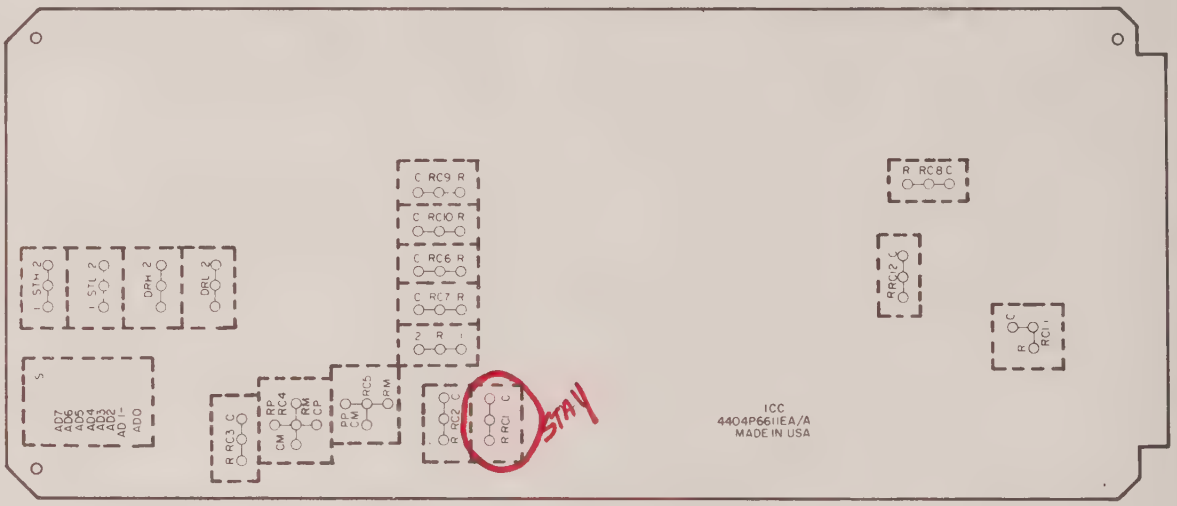
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Auto/ Manual Coupler Selection (Continued) | Auto, ACU "Modem Side of Coupler" |   | Strap LC-2 and LF-1 for automatic coupler (RCD or DAA) with non-TELCO ACU. |
| | Auto, ACU "Line Side of Coupler" |   | Strap LC-2 and LF-2 for automatic coupler (RCD or DAA) with TELCO supplied ACU. |
| | Manual, No Aux. Controller |   | Strap LC-3 and LF-1 for manual coupler (RCD or DAA), without Model 61B Auxiliary Controller. |
| | Manual, with Aux. Controller |   | Strap LC-4 and LF-1 for manual coupler (RCD or DAA) with Model 61B Auxiliary Controller. |
| DSR Control Selection | Internal | | Typical strap setting. DSR control is provided by this PC card. |
| | Permanent | | DSR is always on. |
| Dithertone Generate Selection | With RTS Off | | Typical strap setting. Dithertone is sent when primary channel RTS is off. |
| | Inhibited | | Dithertone is never sent. |
| | Permanent | | Dithertone is constantly sent. |

*Table 2-9: Feature T7, Multipoint Test and Control PC Card, Strap Options*




FEATURE T7, MULTIPOINT TEST AND CONTROL PC CARD, PART NO. 4404P6611E (SLOT N11)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Central/ Remote Site Selection | Central Site | RC1 - C<br>RC2 - C<br>RC3 - C<br>RC6 - C<br>RC7 - C<br>RC8 - C<br>RC9 - C<br>RC10 - C<br>RC11 - C<br>RC12 - C | To prepare the modem Feature T7 for central site operation, set these 10 straps to the C position. |
| | Remote Site | RC1 - C<br>RC2 - R<br>RC3 - R<br>RC6 - R<br>RC7 - R<br>RC8 - R<br>RC9 - R<br>RC10 - R<br>RC11 - R<br>RC12 - R | To prepare the modem Feature T7 for remote site operation, set these 10 straps to the R position. |

*Table 2-9: Feature T7, Multipoint Test and Control PC Card, Strap Options (continued)*

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Multipoint/ P-to-P Selections | Multipoint Central Site | RC4: RM, RP, CP, CM<br>RC5: PP, RM, CM | In a multipoint network strap the central site Feature T7 RC4-CM and RC5-CM. |
| | Multipoint Remote Site | RC4: RM, RP, CP, CM<br>RC5: PP, RM, CM | In a multipoint network strap the remote site Feature T7 RC4-RM and RC5-RM. |
| | P-to-P Central Site | RC4: RM, RP, CP, CM<br>RC5: PR, RM, CM | In a point-to-point network strap the central site Feature T7 RC4-CP and RC5-PP. |
| | P-to-P Remote Site | RC4: RM, RP, CP, CM<br>RC5: PP, RM, CM | In a point-to-point network strap the remote site Feature T7 RC4-RP and RC5-PP. |
| T7 Transmit/ Receive Data Rate Selection | 150 bps | DRH: 2, 1<br>DRL: 2, 1 | For 150 bps transmit/receive data rate strap Feature T7 DRH-1 and DRL-1. |
| | 75 bps | DRH: 2, 1<br>DRL: 2, 1 | For 75 bps transmit/receive data rate strap Feature T7 DRH-1 and DRL-2. |
| T7 Transmit/ Receive Data Rate Selection | 50 bps | DRH: 2, 1<br>DRL: 2, 1 | For 50 bps transmit/receive data rate strap Feature T7 DRH-2 and DRL-1. |

*Table 2-9: Feature T7, Multipoint Test and Control PC Card, Strap Options (continued)*

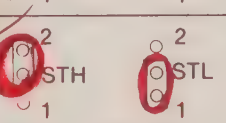
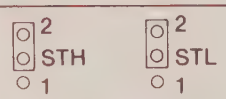
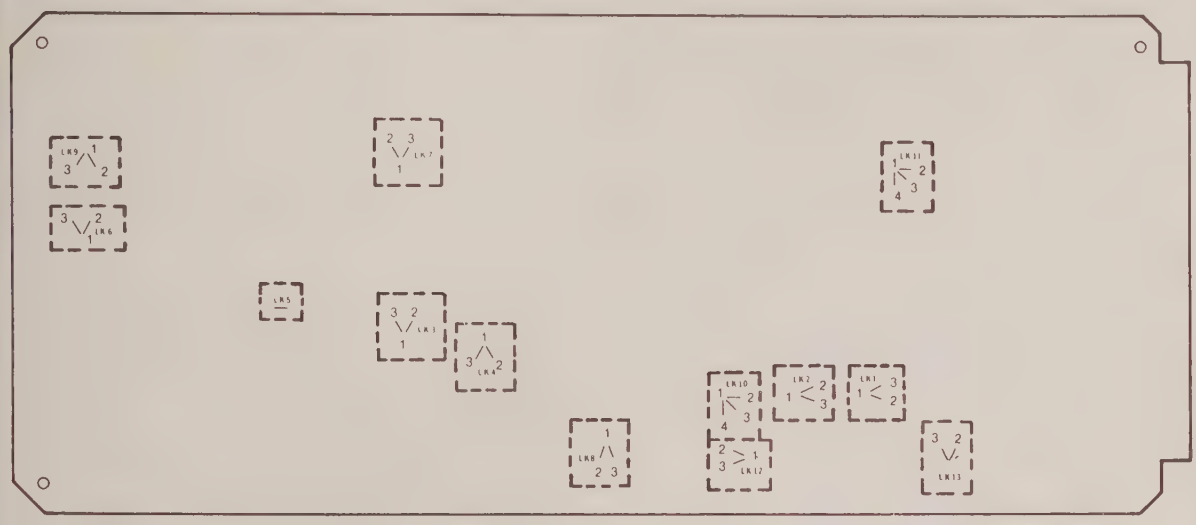
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| T7 Transmit/ Receive Data Rate Selection (Continued) | 37.5 bps | | For 37.5 bps transmit/receive data rate strap Feature T7 DRH-2 and DRL-2. |
| Streaming Alarm Timer Selection | **NOTE:** A central site modem should be strapped for streaming delay, one step longer than the associated remote site modems. | | |
| | 2 Sec. | | For 2 second timer delay, strap STH-1 and STL-1. |
| | 15 Sec. | | For 15 second timer delay, strap STH-1 and STL-2. |
| | 29 Sec. |   | For 29 second timer delay, strap STH-2 and STL-1. |
| | 43 Sec. |   | For 43 second timer delay, strap STH-2 and STL-2. |
| RTS Signal Control Selection | DTE Controlled RTS | | RTS signal is controlled by DTE. |
| | Continuous RTS | | RTS is permanently on to permit continuous carrier transmission. |
| Site Address Encoding | AD7 (MSB)<br>AD6<br>AD5<br>AD4<br>AD3<br>AD2<br>AD1<br>AD0 (LSB) | Use the eight switches in switchbank S1 to compose the assigned address in binary code. A switch in the OPEN position represents a binary 0 and a switch in the closed (alternate) position represents a binary 1.<br><br>Example:<br>1 2 3 4 5 6 7 8<br>7 6 5 4 3 2 1 0<br>0 0 1 0 1 1 0 0<br>128 64 32 16 8 4 2 1 | |

*Table 2-10: Feature M2, Dual-Channel PC Card, Strap Options*



FEATURE M2, DUAL-CHANNEL PC CARD, PART NO. 4404P6601A1 (SLOT N1)

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Channel A Transmit Data Selection | Normal | LK1 | Channel A is set to transmit normal data. |
| | Inverted | LK1 | Channel A is set to transmit inverted data. |
| Channel B Transmit Data Selection | Normal | LK2 | Channel B is set to transmit normal data. |
| | Inverted | LK2 | Channel B is set to transmit inverted data. |
| Channel A Int/Ext Receive Clock | Internal Clock | LK3 | Channel A internal receive clock. |
| | External Clock | LK3 | Channel A external receive clock. |
| Channel A Int/Ext Transmit Clock Selection | Internal Clock | LK4 | Channel A internal transmit clock operation. |

*Table 2-10: Feature M2, Dual-Channel PC Card, Strap Options (continued)*

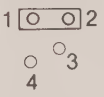
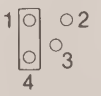
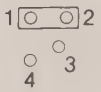
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Channel A Int/Ext Transmit Clock Selection (Continued) | External Clock | LK4 | Channel A external transmit clock operation. |
| | | LK5 | This strap must be left in place for all operations. |
| Mode Enable Selection | Mode 1 Enable | LK6 | Mode 1 is single channel (channel A) operation at 4800 bps, with receive clock retiming. |
| | Mode 2 Enable | LK6 | Mode 2 is single channel (channel A) operation at 4800 bps, no receive clock retiming. |
| Channel B Int/Ext Transmit Clock Selection | Internal Clock | LK7 | Channel B internal transmit clock operation |
| | External Clock | LK7 | Channel B external transmit clock operation. |
| Dual-Channel Required Strapping | | LK8 | Maintain these two strap settings for (LK8 1-3 and LK9 1-3.) Dual-Channel (M2) operation. |
| | | LK9 | |
| Channel B RTS-CTS Delay Selection | 1.9 ms | LK10  | Channel B RTS-CTS delay is 1.9 ms. |
| | 14.8 ms | LK10 | Channel B RTS-CTS delay is 14.8 ms. |
| | 28.2 ms | LK10  | Channel B RTS-CTS delay is 28.2 ms. |
| Channel A RTS-CTS Delay Selection | 1.0/1.9 ms | LK11  | Channel A RTS-CTS delay is 1.0 ms in Mode 2; 1.9 ms in Mode 4. |

*Table 2-10: Feature M2, Dual-Channel PC Card, Strap Options (continued)*

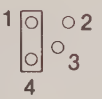
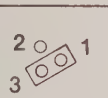
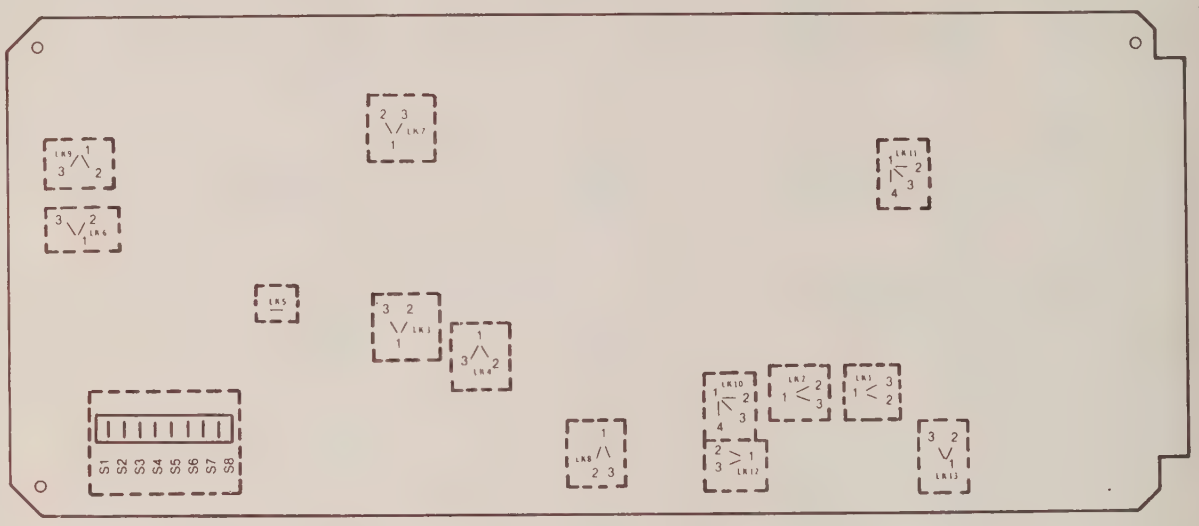
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Channel A RTS-CTS Delay Selection (Continued) | 7.4/14.8 ms | LK11 | Channel A RTS-CTS delay is 7.4 ms in Mode 2; 14.8 ms in Mode 4. |
| | 16.3/28.2 ms | LK11   | Channel A RTS-CTS delay is 16.3 ms in Mode 2; 28.2 ms in Mode 4. |
| Channel A Receive Data Polarity | Normal | LK12 | Channel A is set to receive normal data. |
| | Inverted | LK12   | Channel A is set to receive inverted data. |
| Channel B Receive Data Polarity | Normal | LK13 | Channel B is set to receive normal data. |
| | Inverted | LK13 | Channel B is set to receive inverted data. |

*Table 2-11: Feature M2 + Y4, Dual-Channel and RTS/DCD Simulation PC Card, Strap Options*



FEATURE M2 + Y4, DUAL-CHANNEL AND RTS/DCD SIMULATION PC CARD, PART NO. 4404P6601A (SLOT N1)

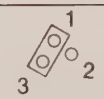
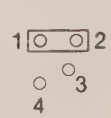
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| | | LK1 through LK7 | The functions of these seven straps are identical to those of corresponding straps described in Table 2-10 for Feature M2. |
| Channel A DCD Drop Code Selection | 6-Bit Repeating Pattern | LK8 | Channel A DCD drop code is a 6-bit repeating pattern. |
| | MARK Pattern | LK8 | Channel A DCD drop code is a MARKING pattern. |
| Channel B DCD Drop Code Selection | 6-Bit Repeating Pattern | LK9 | Channel B DCD drop code is a 6-bit repeating pattern. |
| | MARK Pattern | LK9  | Channel B DCD drop code is a MARKING pattern. |
| Channel B RTS-CTS Delay Selection | 6.4 ms | LK10  | Channel B RTS-CTS delay is 6.4 ms. |

*Table 2-11: Feature M2 + Y4, Dual-Channel and RTS/DCD Simulation PC Card, Strap Options (continued)*

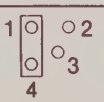
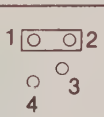
| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Channel B RTS-CTS Delay Selection (Continued) | 19.2 ms | LK10 | Channel B RTS-CTS delay is 19.2 ms. |
| | 32.8 ms |   LK10 | Channel B RTS-CTS delay is 32.8 ms. |
| Channel A RTS-CTS Delay Selection | 3.2/6.4 ms |   LK11 | Channel A RTS-CTS delay is 3.2 ms in Mode 2; 6.4 ms in Mode 4. |
| | 9.6/19.2 ms | LK11 | Channel A RTS-CTS delay is 9.6 ms in Mode 2; 19.2 ms in Mode 4. |
| | 16.4/32.8 ms | LK11 | Channel A RTS-CTS delay is 16.4 ms in Mode 2; 32.8 ms in Mode 4. |
| | | LK12 and LK13 | The functions of these two straps are identical to those of corresponding straps described in Table 2-10 for Feature M2. |
| Switchbank S1 Selections | Switches 1 through 8 | Switch 1 Open | Channel B RTS simulation is enabled. |
| | | Switch 1 Closed | Channel B RTS simulation is disabled. |
| | | Switch 2 Open<br>Switch 3 Open<br>Switch 5 Open<br>Switch 6 Open | DCD drop code is either repeating pattern 001001, or 129 MARKS. |
| | | Switch 2 Open<br>Switch 3 Closed<br>Switch 5 Open<br>Switch 6 Closed | DCD drop code is either repeating pattern 001101, or 65 MARKS. |
| | | Switch 2 Closed<br>Switch 3 Open<br>Switch 5 Closed<br>Switch 6 Open | DCD drop code is either repeating pattern 001010, or 33 MARKS. |

*Table 2-11: Feature M2 + Y4, Dual-Channel and RTS/DCD Simulation PC Card, Strap Options (continued)*

| STRAP DESIGNATION | STRAP OPTION | STRAP POSITION | FUNCTION SELECTED |
|---|---|---|---|
| Switchbank S1 Selections (Continued) | Switches 1 through 8 (Continued) | Switch 2 Closed<br>Switch 3 Closed<br>Switch 5 Closed<br>Switch 6 Closed | DCD drop code is either repeating pattern 101011, or 17 MARKS. |
| | | Switch 4 Open | Channel B DCD simulation is enabled. |
| | | Switch 4 Closed | Channel B DCD simulation is disabled. |
| | | Switch 7 Open | Channel A DCD simulation is enabled. |
| | | Switch 7 Closed | Channel A DCD simulation is disabled. |
| | | Switch 8 Open | Channel A RTS simulation is enabled. |
| | | Switch 8 Closed | Channel A RTS simulation is disabled. |

# SECTION 3

# INSTALLATION PROCEDURES

## GENERAL INFORMATION

This section contains the necessary instructions for on-site installation of Modems MPS 48 and MPS 48 DIAL. The instructions include mechanical operations of rack mounting, DTE and transmission line system connections, as well as ac power connection and pre-operational, or confidence, tests.

## RACK MOUNT INSTALLATION

Modems MPS 48 and MPS 48 DIAL are designed for fixed mounting in a standard 19-inch rack. Slide mounting is not necessary, since the plug-in PC cards in the modems can be inserted and removed from the modem front.

One Rack Mount Kit, Part No. 4404-174A-1, is available for left side mount of a single modem across the rack, or dual mount of two modems, side by side, across the rack. In either single- or dual-modem mount, the modem bezel protrudes from the rack rail to permit bezel removal and access to the PC cards.

Table 3-1 lists the component parts supplied with Kit 4404-174A-1; each part if keyed by item number to the supporting illustrations and the installation procedures.

## SINGLE-MODEM MOUNTING PROCEDURE

Since Kit 4404-174A-1 provides for either single- or dual-modem mount, the following parts are expected to remain after single-modem installation (refer to Table 3-1):

| Item No. | Part | Qty. |
|---|---|---|
| 2 | Side Clamp | 1 |
| 4 | End Trim Plate | 1 |
| 6 | Center Trim Plate | 1 |
| 8 | Flat Washer | 3 |
| 11 | U-Type Speed Nut | 3 |
| 13 | Pan Head Screw | 3 |

Proceed with the rack mount assembly, as follows:

Step 1. See Figure 3-1. Place the mount baffle assembly (1) on a table with the airvent grille to the front.

Step 2. Secure the right trim plate (5) to the center support of the assembly. Use two flat washers (8), two internal tooth lockwashers (9), and two hex nuts (10).

Step 3. Rest the modem upon the supporting tabs provided in the left compartment of the assembly (1). The modem bezel should protrude from the assembly front.

Step 4. Clamp three U-type speed nuts (11) upon the holes on the left side support of the assembly.

Step 5. Locate side clamp (2) upon the left side support of the assembly, so that the jaws on the side clamp engage with the slots on the modem case top, and the holes on side clamp and left side support coincide.

Step 6. Secure side clamp (2) to the left side support of the assembly. Use three flat washers (8) and three pan head screws (13).

Step 7. Clamp two U-type speed nuts (12) upon the holes on the center support of the assembly.

Step 8. Locate two center clamps (3) upon the center support of the assembly, so that the jaws of the center clamps engage with the slots on the modem case, and the holes on the center clamps coincide with the holes on the center support of the assembly.

Step 9. Secure the two center clamps (3) to the center support of the assembly. Use two flat washers (8) and two pan head screws (13).

Step 10. Determine the height on the rack rail at which the mount is to be installed. Accordingly, locate two nut plates (7) behind the rack rails, left and right.

Step 11. Secure each nut plate (7) to its rack rail with two flat head screws (14). See Figure 3-2.

Step 12. Mount the single-modem assembly on the rack. See Figure 3-2. Supporting the modem assembly by hand, position the lateral cutouts of the right trim plate (5) to coincide with the holes on the right rail and the nut plate.

Step 13. Secure the modem assembly with two cup washer fillers (15), two cup washers (16), and two oval head screws (17).

Step 14. At the left side of the modem assembly, position one end trim plate (4) so that the lateral cutouts on the plate coincide with the left lateral cutouts of the assembly, and the holes on the nut plate (7).

Step 15. Secure the modem assembly with two cup washer fillers (15), two cup washers (16) and two oval head screws (17).

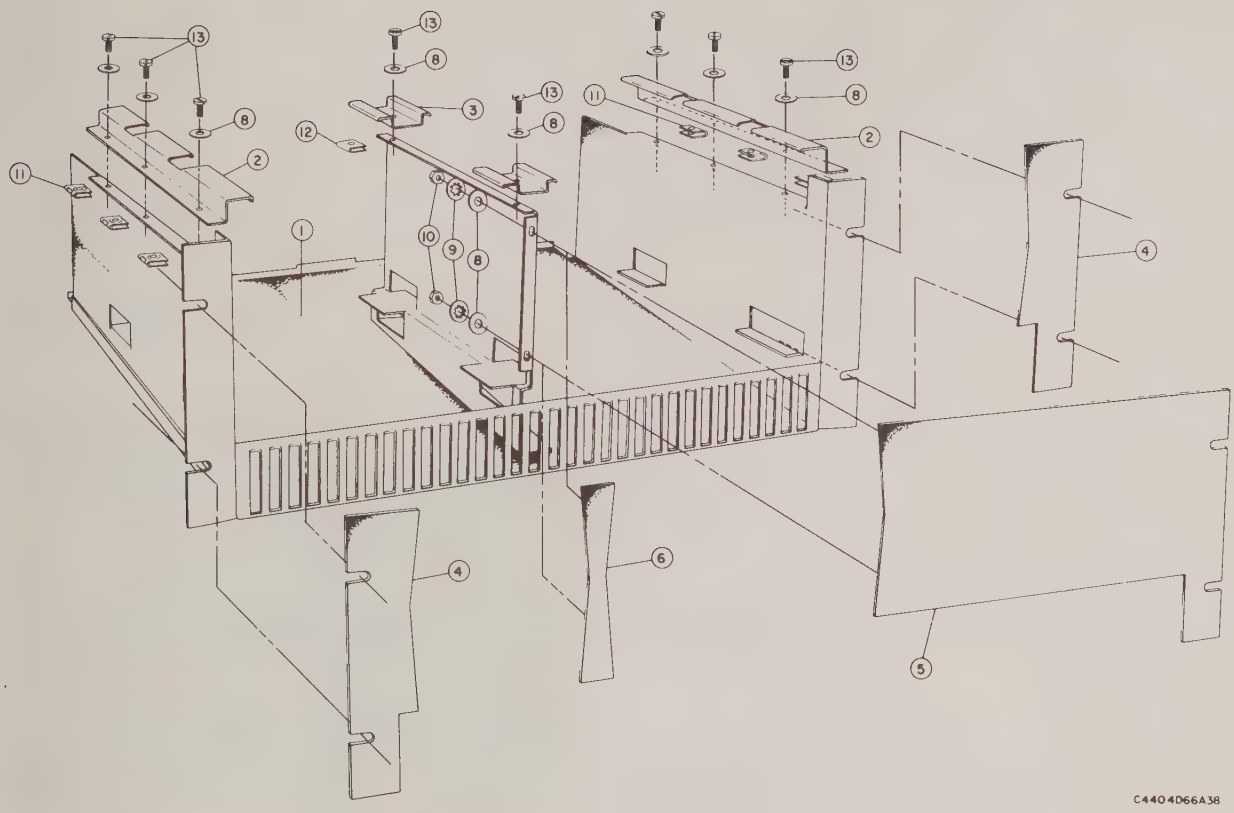



*Figure 3-1: Rack Mount Assembly, Exploded View*

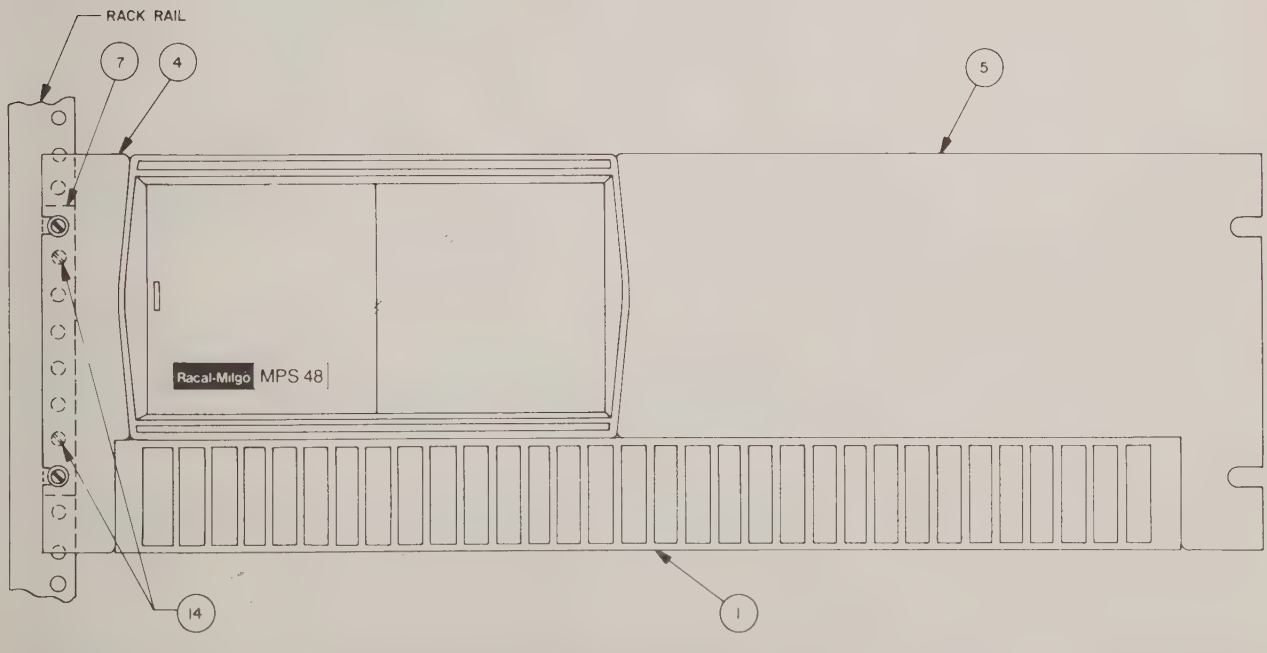



*Figure 3-2: Single-Modem Rack Mount, Front View*

## DUAL-MODEM MOUNTING PROCEDURE

Since Kit 4404-174A-1 provides for either single- or dual-modem mount, right trim plate (Item 5) is expected to remain after dual-modem installation (refer to Table 3-1).

Proceed with the rack mount assembly, as follows:

Step 1. See Figure 3-1. Place the mount baffle assembly (1) on a table, with the airvent grille to the front.

Step 2. Secure the center trim plate (6) to the center support of the assembly. Use two flat washers (8), two internal tooth lockwashers (9), and two hex nuts (10).

Step 3. Rest one modem upon the supporting tabs provided in the left compartment of the assembly (1). Likewise, rest the other modem in the right compartment. The modem bezels should protrude from the assembly front.

Step 4. Clamp three U-type speed nuts (11) upon the holes of the left side support, and three U-type speed nuts (11) upon the holes of the right side support of the assembly.

Step 5. Locate one side clamp (2) upon the left side support of the assembly, so that the jaws on the side clamp engage with the slots on the modem case top, and the holes on the side clamp and left side support coincide.

Step 6. Secure side clamp (2) to the left side support of the assembly. Use three flat washers (8) and three pan head screws (13).

Step 7. Repeat procedure of Steps (5) and (6) to secure the right side clamp.

Step 8. Clamp two U-type speed nuts (12) upon the holes on the center support of the assembly.

Step 9. Locate two center clamps (3) upon the center support of the assembly, so that the jaws of the center clamps engage with the slots on the modem case, and the holes on the center clamps coincide with the holes on the center support of the assembly.

Step 10. Secure the two center clamps (3) to the center support of the assembly. Use two flat washers (8) and two pan head screws (13).

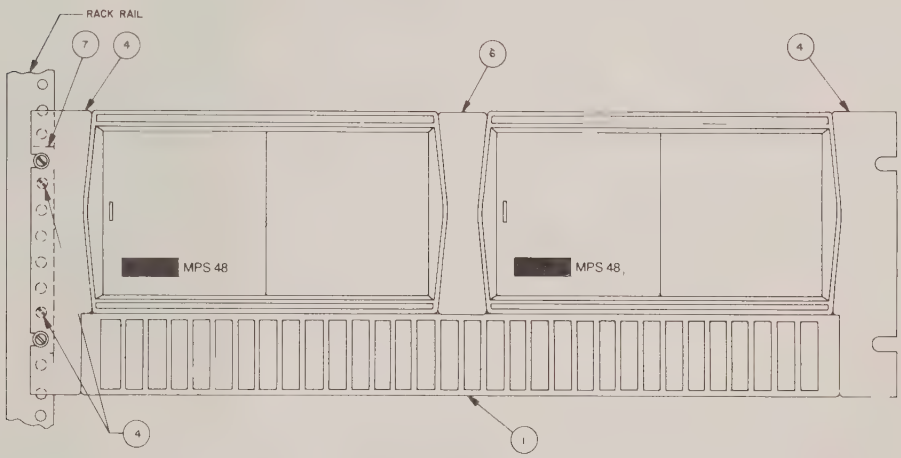
Step 11. Determine the height on the rack rail at which the mount is to be installed. Accordingly, locate two nut plates (7) behind the rack rails, right and left.

Step 12. Secure each nut plate (7) to its rack rail with two flat head screws (14). See Figure 3-3.

Step 13. Mount the dual-modem assembly on the rack. See Figure 3-3. Supporting the modem assembly by hand, position the right end trim plate (4) so that the lateral cutouts on the plate coincide with the right lateral cutouts of the assembly, and the holes on the nut plate (7).

Step 14. Secure the right side of the assembly with two cup washer fillers (15), two cup washers (16), and two oval head screws (17).

Step 15. Secure the left side of the dual-modem assembly folowing the procedure of Steps (13) and (14).




C4404D66A27

*Figure 3-3: Dual-Modem Rack Mount, Front View*

## FAN ADAPTER INSTALLATION

MPS 48 Fan Adapter, Part No. 4404P66DB provides added air flow in table-top Modems MPS 48 operating in high ambient temperatures. The fan adapter is available for domestic applications (Part No. 4404P66DB-2) or for export markets (Part No. 4404P66DB-1).

The domestic applications version contains only the electric fan, receptacle for the modem ac plug, and fan adapter ac power cord. This version has been designed for 115 Vac operation only.

The non-domestic version of the fan adapter can operate with 115 Vac or 230 Vac. This requires a fan adapter transformer connected as an isolation transformer for 115 Vac; or connected as a step-down transformer for 230 Vac. A slide switch in the fan adapter is set for 115 Vac or 230 Vac to match the ac power source. The power cord supplied with this product is for use at voltages up to 130 Vac only; for use at higher voltages replace the plug with one suitable for the application.

To install the fan adapter proceed as follows (refer to Figures 3-4 and 3-5):

(1) Rest the modem on its top surface.

(2) With a pen knife remove the four rubber feet from the bottom of the modem.

(3) Peel off the green cover that protects the adhesive tape on the two support brackets of the adapter (Figure 3-4).

(4) Turn the fan adapter upside down and carefully rest it upon the bottom of the modem. The cable exit in the adapter should coincide with the rear of the modem.

(5) Be sure that the edge tabs on the adapter tray mate with the longitudinal slots on the modem bottom.

(6) Press on the ends of the adapter tray to insure that the tape on the adapter brackets adheres well to the modem.

(7) At each end of the adapter tray remove two screws that attach bracket to tray.

(8) Separate the adapter tray and place it right side up alongside the modem. See Figure 3-5.

(9) Firmly press the two brackets on the modem to insure positive adhesive contact.

(10) Between modem and fan adapter allow a slack of approximately four inches in the modem power cord. Start dressing the power cord around the inside walls of the adapter tray (Figure 3-5).

(11) Three turns of the power cord should permit the plug to reach the power receptacle in the fan adapter tray. Connect the power plug.

(12) (This step is required in the foreign applications version only). Set the slide switch to conform with the available ac power source (230 or 115). For a 230 Vac source, the plug must be changed as previously indicated.

(13) Carefully turn the fan adapter upside down and place it upon the bottom of the modem. The attaching brackets should fit inside the adapter.

(14) Secure fan adapter and modem together with two screws at front and rear of the fan adapter.

(15) Turn the modem assembly right side up.

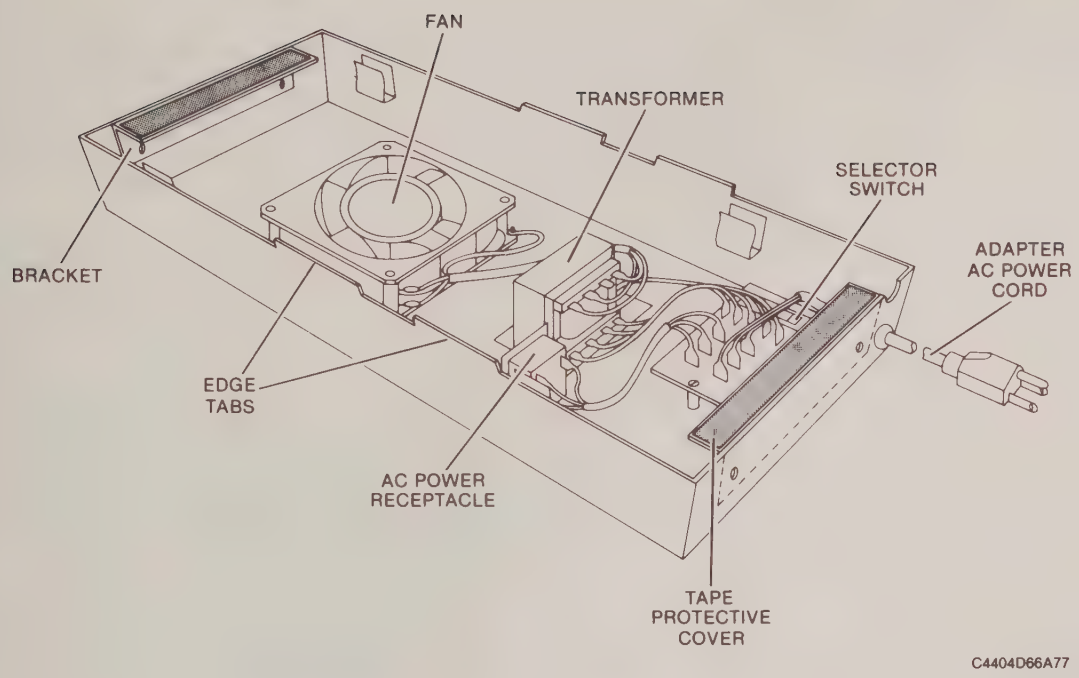



*Figure 3-4: Fan Adapter Components*

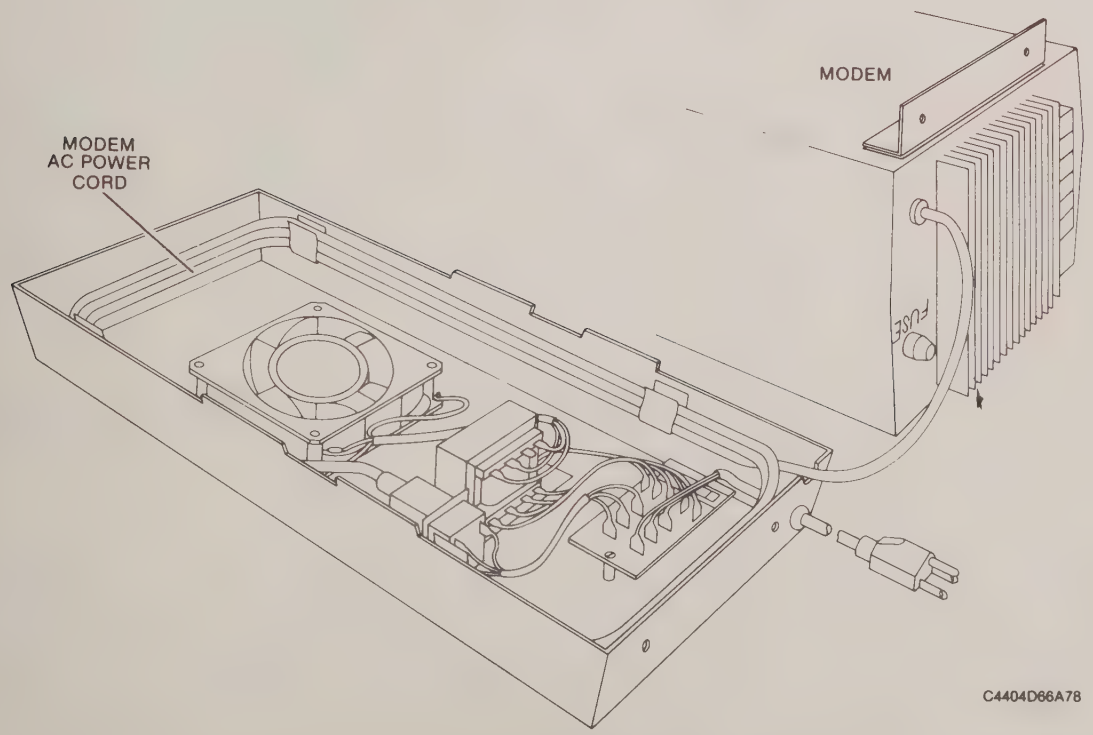



*Figure 3-5: Fan Adapter Prepared for Installation*

## SYSTEM CONNECTIONS

First, modem must be located in its assigned operations area. That is, a table-top modem placed on a suitable flat surface, or rack mounted modem (or modems) completely installed in an equipment rack. Once correctly located, the modem is ready for connections to the external system environment: DTE interface; transmission line interface; optional equipment interface, if any; and ac power source.

To perform these connections it is necessary to be acquainted with the three available versions of the MPS 48 modem, and the cables supplied with the modem according to feature designation.

Early versions of the modem are commonly identified as B chassis modems. Advanced versions are identified as C chassis and D chassis modems. In Table 1-1, C chassis modems have Part No. 4404-66C-XX and D chassis modems have Part No. 4404-66D-XX. Tables 3-2, 3-3 and 3-4 describe receptacles J1 and J2 pin/signal assignments corresponding to C, D and B chassis MPS 48 modems.

## CABLE DESCRIPTION

The following seven cables are used in the installation of various MPS 48 modems.

**Model 160TS Cable, Part No. 4402K601E.** This cable connects Model 160TS to receptacle J2 of the modem. See Figure 3-6.

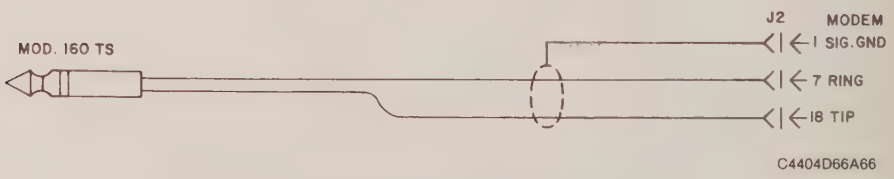



*Figure 3-6: Cable, Part No. 4404K601E*

**System 185 NDC Cable, Part No. 5956K105J.** This cable connects System 185 NDC to receptacle J2 of the central site modem. See Figure 3-7.

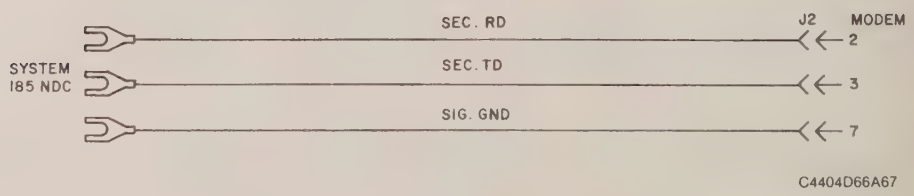



*Figure 3-7: Cable, Part No. 5956K105J*

**Secondary Channel (S2) Cable, Part No. 5956K100U.** This cable connects modem terminals at receptacle J2 to the DTE secondary channel source. See Figure 3-8.

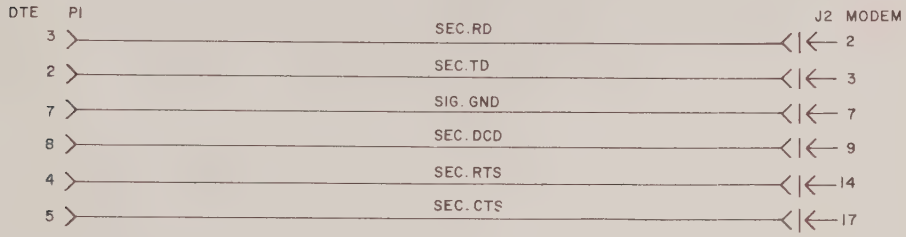
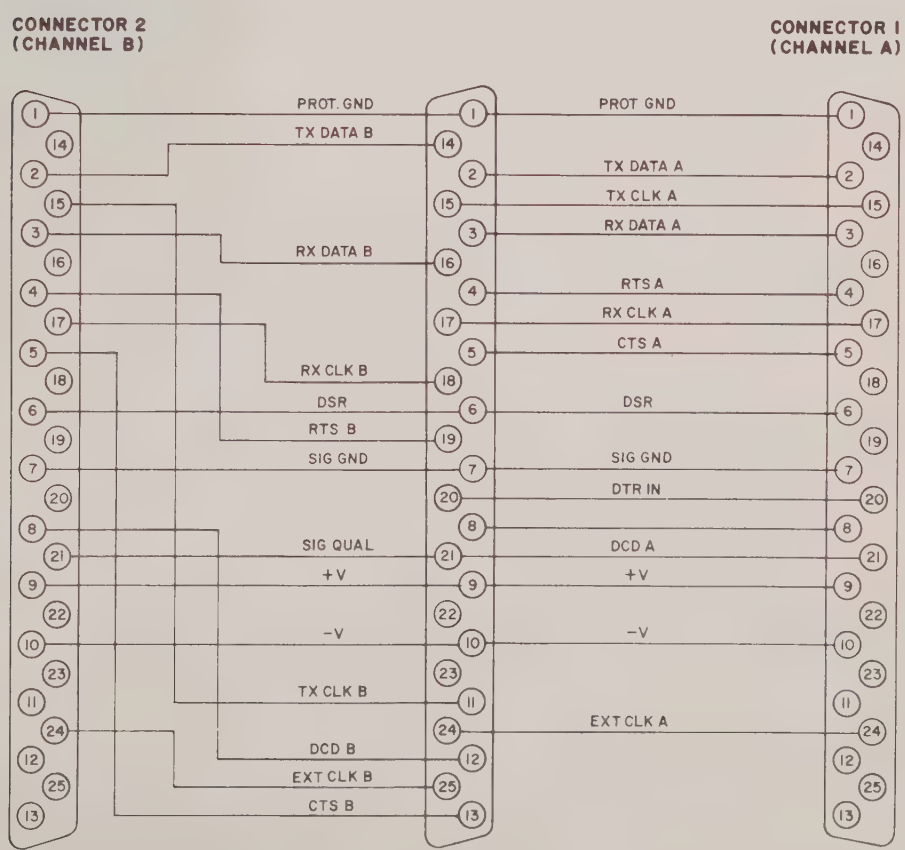



*Figure 3-8: Cable, Part No. 5956K100U*

C4404D66A68

**Dual-Channel (M2) Cable, Part No. 4402K96A.** This cable simultaneously connects receptacle J1 (DTE) of the modem to Connector 1 going to Channel A data source and to Connector 2 going to Channel B data source. See Figure 3-9.




C4404D66A69

*Figure 3-9: Cable, Part No. 4402-96A*

**C or D Chassis to B Chassis Conversion Cable, Part No. 5956K27A.** This cable, illustrated in Figure 3-10, provides three 25-pin connector: J1 (female) which adapts to a C or D chassis modem, J1 (DTE) receptacle; J2 (male) which adapts to a B chassis modem, J1 (DTE) receptacle; and P1 (female) which adapts to a point of Secondary Channel or T7 feature information exchange.

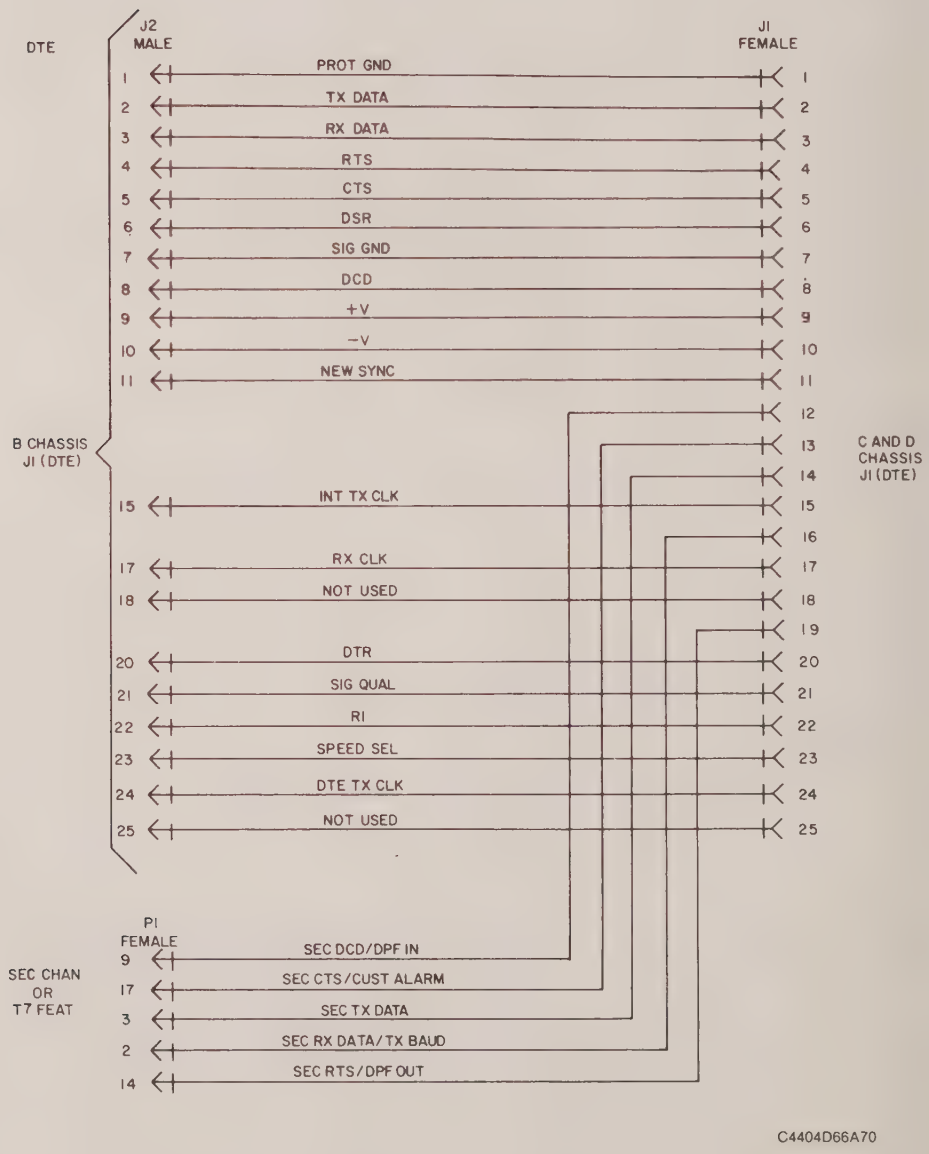



*Figure 3-10: Cable, Part No. 5956K27A*

**Dial Backup Interface Main Cable, Part No. 5956K118B-10.** This cable connects receptacle J2 of a Feature D MPS 48 modem with the coupler device (RCD or DAA). Note that the DT and DR spade lugs of this cable must be individually isolated with tape and secured to the main cable. See Figure 3-11.

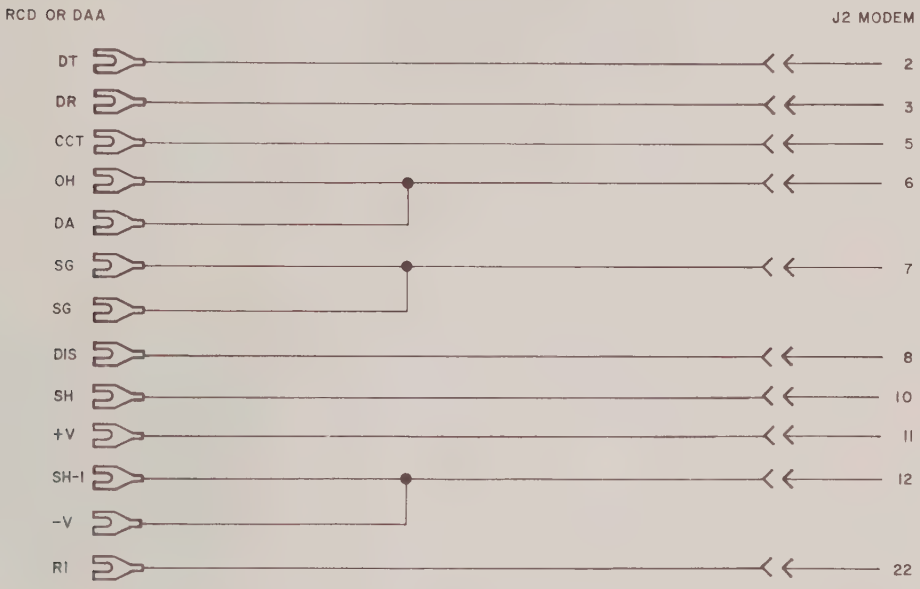



*Figure 3-11: Cable, Part No. 5956K118B-10*

**Dial Backup Interface Auxiliary Cable, Part No. 5956K120B-10.** This cable connects the DT and DR terminals of the coupler device, respectively to TB1 terminals 1 and 2 of a Feature D MPS 48 modem. See Figure 3-12.

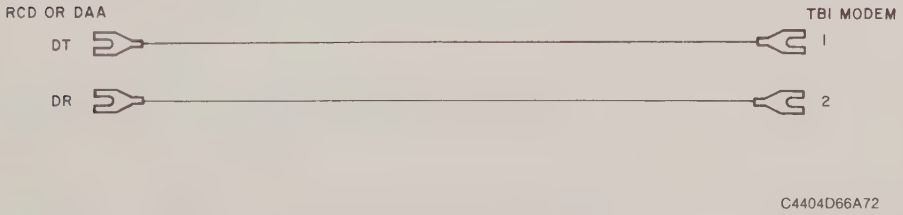



*Figure 3-12: Cable, Part No. 5956K120B-10*

## DATA TERMINAL EQUIPMENT (DTE) INTERFACE

Connect the modem to the DTE at receptacle J1 (Figure 1-2) with a Cinch or Cannon DB-25P male plug, or equivalent. The Cinch plug also requires a DB-51226-1A hood. DTE receptacle J1 is a standard 25-pin male receptacle, and AUX receptacle J2 is a standard 25-pin male receptacle. Refer to Tables 3-2, 3-3 and 3-4.

## TRANSMISSION LINE INTERFACE

**Private (Leased) Lines** are connected directly to terminal barrier TB1 at the rear of the modem (Figure 3-13). For 2-wire service, connect the transmission lines to TB1 terminals 1 and 2. For 4-wire service, connect the send pair to terminals 1 and 2 and the receive pair to terminals 3 and 4.

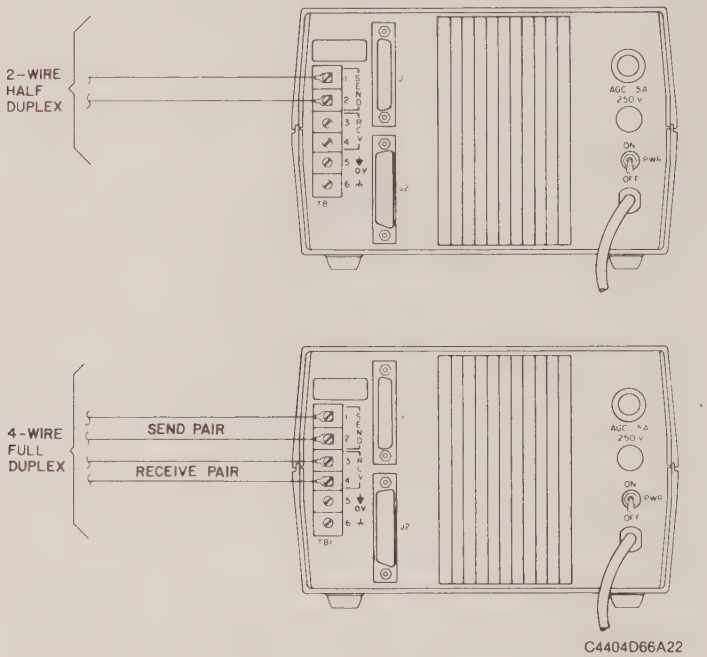



*Figure 3-13: Private (Dedicated) Line Service, Modem Connections*

TB1 terminals 5 and 6 are for signal common and frame (chassis) ground, respectively. Normally, terminals 5 and 6 are connected together at the factory with a saddle jumper. Unusual ground conditions at certain sites may require separation of signal common from frame ground; however, before removing the saddle jumper, consult the Racal-Milgo representative.

**Dual-Up Lines** can be used by MPS 48 DIAL (Feature D) modems, since these units are equipped with CBS/CDT Adapter PC card. Dial-up lines are brought up to the modem through one of two main coupler devices: Registered Connecting Device (RCD) installed and maintained by Racal-Milgo; or Data Access Arrangement (DAA), installed and maintained by the telephone company. An automatic or manual type RCD can be interchanged with a DAA of the same type (CBS auto or CDT manual).

**NOTE**

Under Federal Communication Commission (FCC) Rules, Part 68, no customer (user) is authorized to install, connect or repair RCD devices. Refer to Racal-Milgo Instruction Manual, Part No. 4402D207A1, Model 68 Registered Connecting Devices.

Dial-up lines are connected to the modem in one of the following four configurations:

(1) Two-wire with neither automatic answer nor Model 61B Auxiliary Controller (Table 1-3). This configuration requires one Manual RCD coupler or equivalent DAA type CDT or WECo1000A. Modem to coupler connection is made with a twisted pair, 24 AWG or heavier. See Figure 3-14.

(2) Four-wire with neither automatic answer nor Model 61B Auxiliary Controller. This configuration requires two Manual RCD couplers or two DAA couplers type CDT and twisted pair 24 AWG or heavier.

(3) Two-wire with automatic answer. This configuration requires one Automatic RCD coupler or DAA coupler type CBS. Modem to coupler connection is made with Cables Part No. 5956-118B-10 and 5956-120B-10 as shown in Figure 3-15.

(4) If the CBS/CDT adapter PC card is strapped for Line Current Status Indication (LCSI) automatic disconnect (Table 2-8, LB-2), connect cable 5956-118B-10 lug DIS to one of the two unlabelled terminals in the coupler, and lug SG to the other unlabelled terminal in the coupler. See Figure 3-16.

**Line Switching Installations** enables an MPS 48 modem to be switched manually or automatically between 4-wire private line and 4-wire dial-up line service.

Figure 3-17 shows the MPS 48 DIAL modem connected to Racal-Milgo Model 21B Line Adapter. This unit provides manual switching between private and dial backup lines, 2-wire or 4-wire service. When switched to dial backup, telephone line connection reaches the modem through a Data Jack installed by the telephone company, Racal-Milgo Model 68M RCD Manual (or equivalent DAA), and Racal-Milgo Model 21B Line Adapter.

Figure 3-18 shows an MPS 48 modem connected to Racal-Milgo Model 121A Auto-Line Adapter. This unit provides manual line switching, or automatic line switching by remote control from a Feature B + T7, or C + T7 modem.

When switched to dial backup, the telephone line reaches the modem through a Data Jack installed by the telephone company, Racal-Milgo Model 68A RCD Automatic coupler (or equivalent DAA coupler), and Racal-Milgo Model 121A Auto Line Adapter.

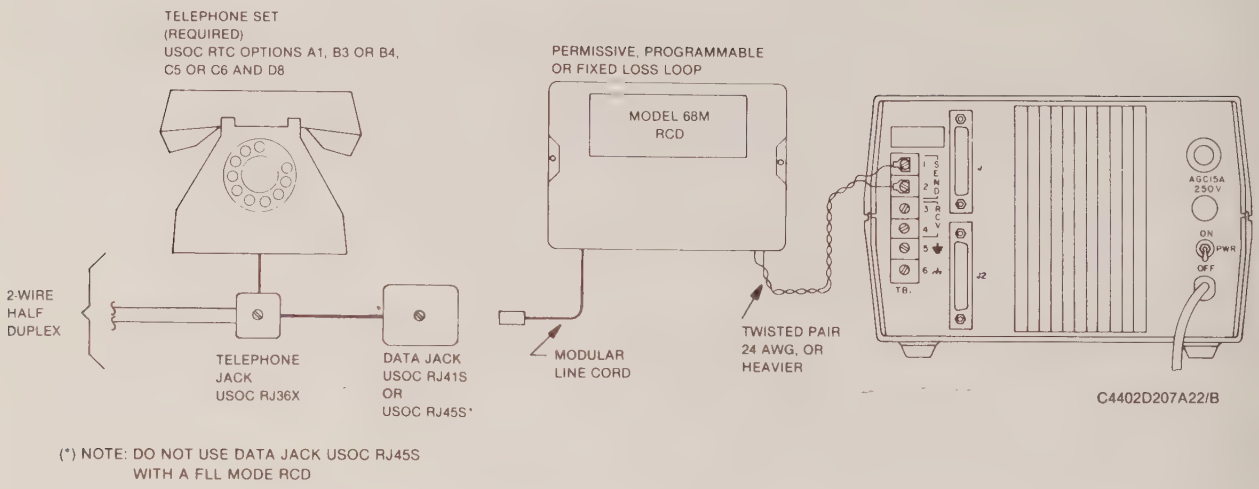



*Figure 3-14: Dial-Up Line Service - No Auto Answer, Modem Connections*

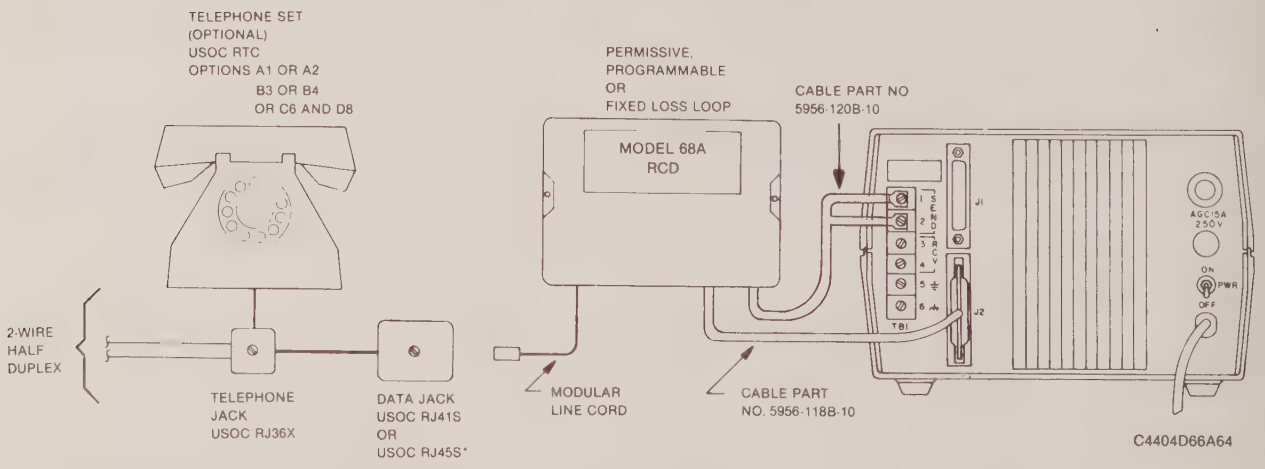



*Figure 3-15: Dial-Up Line Service - Auto Answer, Modem Connections*

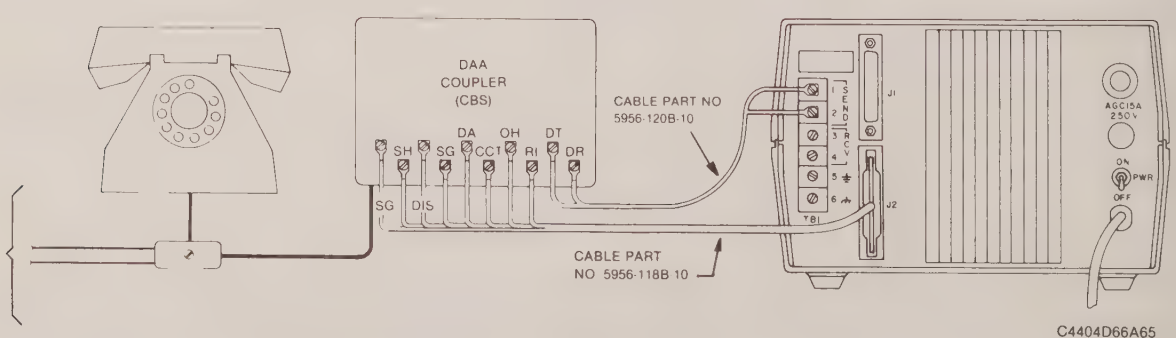



*Figure 3-16: Dial-Up Line Service, Coupler Type CBS Connected for LCSI Operation*

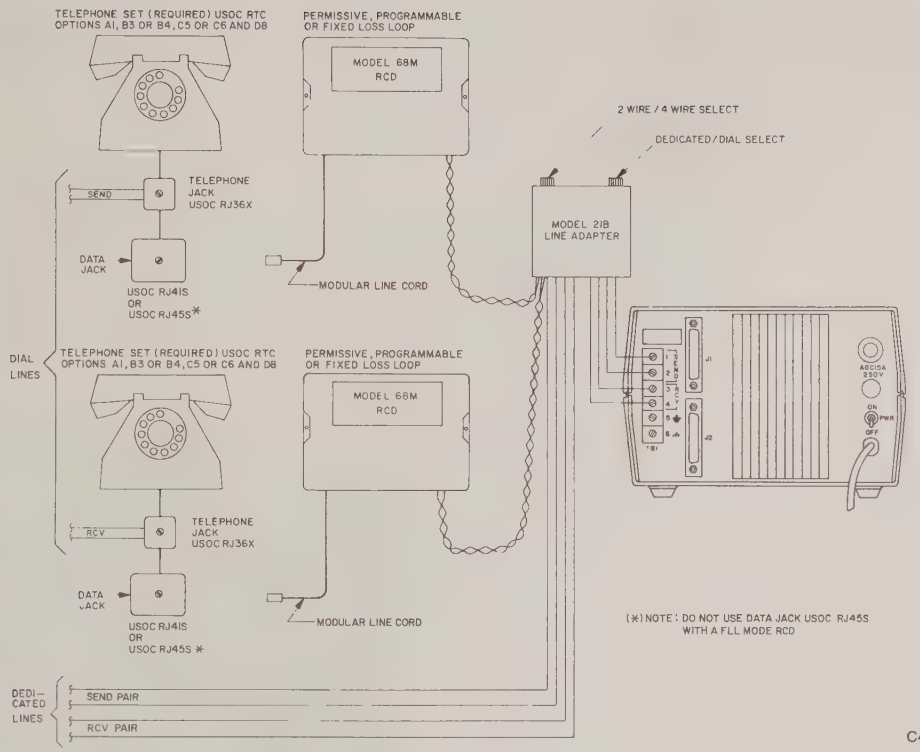

TELEPHONE SET (REQUIRED) USOC RTC OPTIONS A1, B3 OR B4, C5 OR C6 AND D8
PERMISSIVE, PROGRAMMABLE OR FIXED LOSS LOOP
MODEL 68M RCD
2 WIRE / 4 WIRE SELECT
DEDICATED/DIAL SELECT
MODEL 21B LINE ADAPTER
SEND
TELEPHONE JACK USOC RJ36X
DATA JACK
USOC RJ41S OR USOC RJ45S*
MODULAR LINE CORD
DIAL LINES
TELEPHONE SET (REQUIRED) USOC RTC OPTIONS A1, B3 OR B4, C5 OR C6 AND D8
PERMISSIVE, PROGRAMMABLE OR FIXED LOSS LOOP
MODEL 68M RCD
RCV
TELEPHONE JACK USOC RJ36X
DATA JACK
USOC RJ41S OR USOC RJ45S *
MODULAR LINE CORD
(*) NOTE: DO NOT USE DATA JACK USOC RJ45S WITH A FLL MODE RCD
DEDICATED LINES
SEND PAIR
RCV PAIR
C4402D207A24/B

*Figure 3-17: Four-Wire Private/Dial-Up Manual Line Switching Installation*

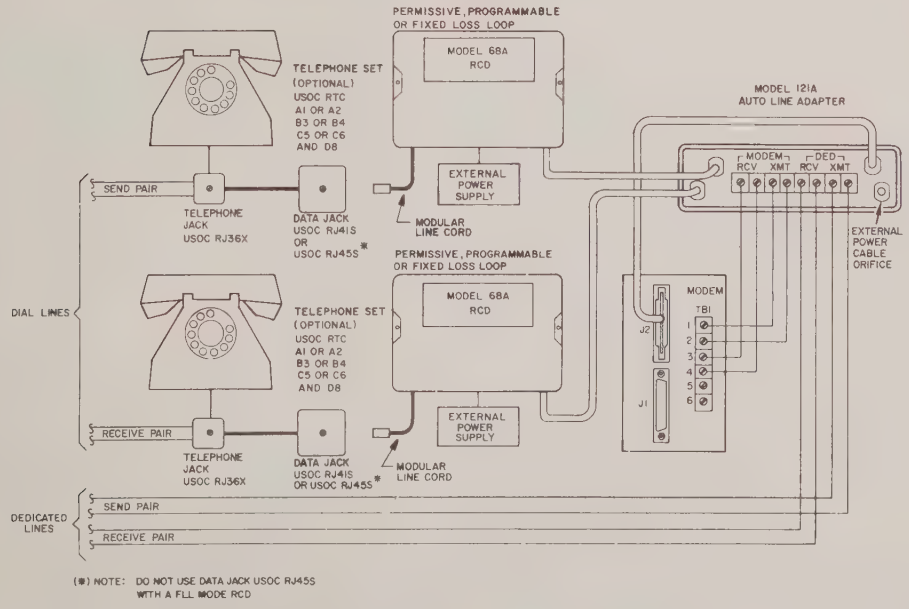

PERMISSIVE, PROGRAMMABLE OR FIXED LOSS LOOP
MODEL 68A RCD
TELEPHONE SET (OPTIONAL) USOC RTC A1 OR A2 B3 OR B4 C5 OR C6 AND D8
MODEL 121A AUTO LINE ADAPTER
MODEM RCV XMT
DED RCV XMT
SEND PAIR
TELEPHONE JACK USOC RJ36X
DATA JACK USOC RJ41S OR USOC RJ45S *
EXTERNAL POWER SUPPLY
MODULAR LINE CORD
EXTERNAL POWER CABLE ORIFICE
PERMISSIVE, PROGRAMMABLE OR FIXED LOSS LOOP
MODEL 68A RCD
MODEM
TBI
DIAL LINES
TELEPHONE SET (OPTIONAL) USOC RTC A1 OR A2 B3 OR B4 C5 OR C6 AND D8
RECEIVE PAIR
TELEPHONE JACK USOC RJ36X
DATA JACK USOC RJ41S OR USOC RJ45S *
EXTERNAL POWER SUPPLY
MODULAR LINE CORD
DEDICATED LINES
SEND PAIR
RECEIVE PAIR
(*) NOTE: DO NOT USE DATA JACK USOC RJ45S WITH A FLL MODE RCD
C4402D207A25/01

*Figure 3-18: Four-Wire Private/Dial-Up Automatic Line Switching Installation*

AC POWER CONNECTION

Before plugging the modem ac power connector into the ac power outlet, be sure that the power source in the modem (Refer to Table 1-2) is suitable for the ac power source available.

Set PWR ON/OFF Switch to OFF. See Figure 1-2.

The power cord is supplied with suffix symbol U modems (Table 1-2) is UL approved, and has a 3-prong plug for standard 110 Vac power outlet. Suffix Symbol W modems are supplied with a plug for 208-volt nominal operation. Voltage ranges and power cord terminations may be changed to meet special requirements. Consult Racal-Milgo representative.

**PRE-OPERATION CHECKS**

When modem installation is complete, perform the following checks before connecting the modem(s) to the ac power outlet.

(1) Strapping locations must be checked for accuracy and for firm connection of strap jumpers over strap pins.

(2) DTE cable connector must be firmly seated on receptacle J1 and secured with the screws on the connector.

(3) Private lines or dial-up lines, as required, must be firmly connected to TB1 at the rear of the modem. Two-wire circuits connect to TB1 terminals 1 and 2. Four-wire circuits send pair connects to TB1 terminals 1 and 2; receive pair connects to TB1 terminals 3 and 4.

(4) Dial-up (PSTN switched) line connection is made in one of two ways: In 2-wire, No Auto Answer installations (Figure 3-14), through twisted pair 24 AWG to TB1 terminals 1 and 2. In 2-wire Auto Answer installations, through cables 5956-120B-10 and 5956-118B-10 (Figures 3-15 and 3-16).

(5) Check that pushbuttons RO (or RT), DL, AL and ET in the transmitter PC card (Figures 4-1 and 4-2) are in the released, "Out" position.

(6) Check that the PWR ON/OFF switch is in the OFF, position.

**CONFIDENCE TESTS**

After the installation of a modem or modems has been completed and verified, each newly installed modem is self tested first. Next, two distant modems are connected in an End-to-End configuration for a system test.

ERROR COUNT

Self tests and system tests employ the modem built-in test generator and comparator to provide a visual error count at the ER indicator. The error count denotes the operating quality of the end modems and the transmission line.

For an "error free" condition, one error is allowed for every 100,00 bits of data. However, due to the fast data bit rate (4800 bps), one flash of the ER indicator may denote up to three errors. Therefore, in a 3-minute (864,000 bits) test, the ER indicator is allowed to flash a maximum of 3 times and still denote an "error free" condition.

## MODEM SELF TEST

This test electronically disconnects an installed modem from the DTE and the transmission lines; therefore, a self test may be conducted on a MPS 48 modem, at any time after it arrives at the site. Proceed with self test as follows:

(1) Place the PWR ON/OFF switch on the ON position. The PWR indicator should light.

(2) Depress the AL and ET pushbuttons in the transmitter PC card. The TST indicator should light. In this condition, the modem is in self test. The ET pushbutton activates the test pattern generator and comparator, and the AL pushbutton allows the test pattern to circulate through the modulator (transmitter) and the demodulator (receiver) of the modem.

Except for an initial flash, the ER indicator should not light at all in modem self test. Since the test pattern travel is restricted to internal modem circuits, no allowance should be made for error.

(3) Release the AL pushbutton, and place two wire jumpers at TB1 on the rear panel, thus:

These jumpers extend the analog loop (AL) to include the transmission line interface. The ER indicator should not light during self test when the extended analog loop is installed.

If the ER indicator lights during the first or second portion of self test, the modem is considered defective and should be replaced.

## MODEM SYSTEM TEST

When each of the modems in the network has successfully passed the self test, a system End-to-End test between two modem sites is conducted.

In a multidrop network only the central site modem and one remote site modem should be connected to ac power for system test. All other remote modems should be disconnected.

Proceed with End-to-End system test as follows:

(1) Use voice communication to agree with a remote site operator to go on a system test. Request the operator to depress only the ET pushbutton. This causes the test pattern to be transmitted by the far-end modem.

(2) At the local modem, check that the DCD indicator lights. This denotes that the test pattern carrier signal from the far-end modem is being received.

(3) At the local modem, depress the ET pushbutton. Now, local and far-end modems are in End-to-End system test.

(4) At the local modem, conduct the three-minute error count.

(5) If the error count exceeds the allowable amount, refer to strap adjustments described in TRANSMISSION LINE CONSIDERATIONS.

(6) At the local modem temporarily release the ET pushbutton to ensure that the DCD indicator lights. Depress the ET pushbutton again.

(7) Ensure that a minimum error count is reached when strap adjustments are made in the following order:

(a) RTS-CTS Delay

(b) Transmitter Timing

(c) RX Preamplifier Gain

(8) Use voice communication to request the modem operator at the far-end, to perform strap checks and adjustments as indicated in steps (2) through (7) of this paragraph.

*Table 3-1: Rack Mount Assembly Kit, Part No. 4404-174A-1*

| ITEM NO. | PART NO. | QTY. | PART DESIGNATION |
|---|---|---|---|
| 1 | 4404-175AA-2 | 1 | Mount Baffle Inseparable Assembly |
| 2 | 4404-173A1 | 2 | Side Clamp |
| 3 | 4404-174A1 | 2 | Center Clamp |
| 4 | 4404-174A2-2 | 2 | End Trim Plate |
| 5 | 4404-174AB-4 | 1 | Right Trim Plate (Single) |
| 6 | 4404-175AB-2 | 1 | Center Trim Plate (Dual) |
| 7 | 4404-174A3 | 2 | Nut Plate |
| 8 | 21C114-06 | 11 | Flat Washer |
| 9 | 21C116-06 | 2 | Internal Tooth Lock Washer |
| 10 | 21C119-06 | 2 | Hex Nut |
| 11 | 21C168-02 | 6 | U-Type Speed Nut (Sides) |
| 12 | 21C168-10 | 2 | U-Type Speed Nut (Center) |
| 13 | 21C115-0605 | 8 | Pan Head Screws |
| 14 | 21C143-1008 | 4 | Flat Head Screw |
| 15 | 21C204-10 | 4 | Cup Washer Filler |
| 16 | 21C205-10C | 4 | Cup Washer |
| 17 | 21C206-1012 | 4 | Oval Head Screw |

*Table 3-2: Receptacle J1 (DTE) Pin/Signal Assignments for Dual-Channel Operation - C Chassis*

| PIN NO. | CCITT V.24 SYMBOL | RS232 SYMBOL | INPUT/ OUTPUT | FUNCTION |
|---|---|---|---|---|
| 1 | 101 | AA | — | Protective ground. Provides common ground for chassis and ac power. |
| 2 | — | — | Input | TX Data - Channel A |
| 3 | — | — | Output | RX Data - Channel A |
| 4 | — | — | Input | RTS - Channel A |
| 5 | — | — | Output | CTS - Channel A |
| 6 | 107 | CC | Output | Data Set Ready - DSR |
| 7 | 102 | AB | — | Signal ground. Common ground reference for all circuits, except protective ground (Pin 1). |
| 8 | — | — | Output | DCD - Channel A |
| 9 | — | — | Output | Test + 12V |
| 10 | — | — | Output | Test – 12V |
| 11 | — | — | Output | TX Clock - Channel B/New Sync |
| 12 | — | — | Output | DCD - Channel B |
| 13 | — | — | Output | CTS - Channel B/Cont 1 |
| 14 | — | — | Input | TX Data - Channel B/Cont 6 |
| 15 | — | — | Output | TX Clock - Channel A to DTE |
| 16 | — | — | Output | RX Data - Channel B/Cont 5 |
| 17 | — | — | Output | RX Clock - Channel A |
| 18 | — | — | Output | RX Clock - Channel B/Cont 2 |
| 19 | — | — | Input | RTS - Channel B/Cont 4 |
| 20 | — | — | Input | Data Terminal Ready - DTR |
| 21 | — | — | Output | Signal Quality |
| 22 | — | — | Output | Ring Indicator |
| 23 | — | — | Input | Data Signal Rate Selector |
| 24 | — | — | Input | DTE TX Clock to Channel A |
| 25 | — | — | Input | DTE TX Clock to Channel B |

**NOTE:** Receptacle J1 (DTE) in D Chassis modems has identical pin/signal assignments, except that Cont 1, 6, 5, 2 and 4 are not available at pins 13, 14, 16, 18 and 19.

*Table 3-3: Receptacle J2 Pin/Signal Assignments - C and D Chassis*

| PIN NO. | SIGNAL NAME | INPUT/ OUTPUT | FUNCTION | FEATURE |
|---|---|---|---|---|
| 1 | Protective Ground | — | Common for chassis and ac power ground. | — |
| 2 | SBB | Input | Secondary Channel Received Data. | S2 |
| 3 | SBA | Output | Secondary Channel Transmit Data. | S2 |
| 4 | DTR | Output | Data Terminal Ready. | |
| 5 | CCT | Input | Coupler Cut Through. | D |
| | | | Control 3. | — |
| 6 | OH/DA | Output | Off Hook/Data Access signal to a DAA or RCD, type CBS. | D |
| | Ded/Dial-F | Output | This T7 output bit causes Model 121A ALA to switch the modem between dedicated and dial lines. | T7 |
| 7 | Signal Ground | — | Common ground reference potential for all circuits, except protective ground (pin 1). | — |
| 8 | LCSD | Input | Line Current Status Disconnect signal from a DAA or RCD, type CBS. | D |
| | Disconnect | Output | This T7 output bit causes Model 121A ALA to disconnect the dial lines. | T7 |
| 9 | SCF | Output | Secondary Channel DCD in modems with feature S2 or T7, and strapped for central-site operation. | S2 or T7 |
| | $\overline{\text{Digital Power Failure Input}}$ | Input | Available in remote modems equipped with T7 option (N11E board, Part No. 6611D-1, strap RC1 to R). An ON condition (zero volts) on this pin indicates that a power failure has occurred in equipment attached to modem; e.g., a failure in a second-tier control modem in a multi-tier system. | T7 |
| 10 | SH | Input | Switch Hook signal from a DAA or RCD, type CBS. | D |
| | Dial Mode | Input | This input bit from Model 121A ALA indicates to the T7 feature circuits that the modem is connected to the dial lines. | T7 |
| 11 | +V | Output | Direct Connection to −12V power. | — |
| 12 | −V | Output | Direct Connection to −12V power. | — |

*Table 3-3: Receptacle J2 Pin/Signal Assignments - C and D Chassis (Continued)*

| PIN NO. | SIGNAL NAME | INPUT/ OUTPUT | FUNCTION | FEATURE |
|---|---|---|---|---|
| 13 | VA Disable | Input | Disable Modem signal from Model 16 Voice Adapter. +5V (open) = Data operation. OV (ground) = Voice operation. | — |
| 14 | SCA | Input | Secondary Channel RTS for remote modems equipped with feature T7 (N11E board strap RC8 to R), and any modem equipped with S2. | S2 or T7 |
| | $\overline{\text{Digital Power Failure Output}}$ | Output | Available in central modems equipped with feature T7 (N11E board, Part No. 6611D-1, strap RC8 to C). An ON condition (zero volts) indicates that a power failure has occurred in the central site modem. | T7 |
| 15 | VA Receive | Output | Voice Adapter Model 16 receive line signal output. | — |
| 16 | 2-Wire Enable | Input | External 2-wire enable command. +5V (open) = 2-wire operation. OV (ground) = 4-wire operation. | — |
| 17 | SCB | — | Secondary Channel CTS. | S2 |
| | Customer Alarm | Output | Customer Alarm. An on condition (0 Volts) on this pin causes the T7 feature circuits to transmit a Customer Alarm Mayday. | T7 |
| 18 | VA Transmit | Output | Transmit Line signal for Model 16 Voice Adapter. | — |
| 19 | Digloop-F | Input | External digital loop command. | — |
| 20 | Self Test-F | Input | External self test command. | — |
| 21 | Analog-F | Input | External analog loop command. | — |
| 22 | RI | Input | Ring Indicator. Signal from a DAA or RCD, type CBS. | — |
| 23 | X EYE | Output | X Axis Eye Pattern Signal. Provides eye pattern signal from modem receiver to external oscilloscope. | — |
| 24 | Y EYE | Output | Y Axis Eye Pattern Signal. Provides eye pattern signal from modem receiver to external oscilloscope. | — |
| 25 | +5V | Output | Direct Connection to +5V power. | — |

*Table 3-4: Receptacle J1 (DTE) Pin/Signal Assignments - B Chassis*

| PIN NO. | CCITT V.24 SYMBOL | RS232 SYMBOL | INPUT/ OUTPUT | FUNCTION | FEATURE |
|---|---|---|---|---|---|
| 1 | 101 | AA | — | Protective ground. Provides common for chassis and ac power. | — |
| 2 | 103 | BA | Input | Transmit (TX) Data. Serial binary signals from DTE. | — |
| 3 | 104 | BB | Output | Received (RX) Data. Serial binary signals to DTE. | — |
| 4 | 105 | CA | Input | Request To Send (RTS). An on condition indicates DTE is ready to send primary channel data. | — |
| 5 | 106 | CB | Output | Clear To Send (CTS). Indicates the modem is ready to transmit primary channel data. | — |
| 6 | 107 | CC | Output | Data Set Ready (DSR). Indicates that the modem is in in normal operation, and ready to transmit and receive data. | — |
| 7 | 102 | AB | — | Signal ground. Common ground reference for all circuits, except protective ground (pin 1). | — |
| 8 | 109 | CF | Output | Data Carrier Detected (DCD). Indicates that the modem is receiving a carrier signal from the remote modem. | — |
| 9 | — | — | Output | Test +12V. | — |
| 10 | — | — | Output | Test −12V. | — |
| 11 | — | — | Input | New Sync. An on condition for more than 0.4 ms simulates loss of carrier. Used with special polling networks only. | — |
| 12 | 122 | SCF | Output | Secondary Channel DCD. | S2 |
| | — | — | Input | Digital Power Failure input. | T7 |
| 13 | 121 | SCB | Output | Secondary Channel CTS. | S2 |
| | — | — | Input | Customer Alarm. | T7 |

*Table 3-4: Receptacle J1 (DTE) Pin/Signal Assignments - B Chassis (continued)*

| PIN NO. | CCITT V.24 SYMBOL | RS232 SYMBOL | INPUT/ OUTPUT | FUNCTION | FEATURE |
|---|---|---|---|---|---|
| 14 | 118 | SBA | Input | Secondary Channel TX Data. | S2 |
| 15 | 114 | DB | Output | TX Clock | — |
| 16 | 119 | SBB | Output | Secondary Channel RX Data. | S2 |
| 16 | — | — | Output | Optionally, pin 16 may be assigned to transmit baud clock signal sent to the DTE at the 1600 Hz baud rate. | — |
| 17 | 115 | DD | Output | RX Clock | — |
| 18 | — | — | Input | Control 5. Input control bit for monitoring the state of external equipment (TTL level). | T7 |
| 19 | 120 | SCA | Input | Secondary Channel RTS. | S2 |
| | — | — | Output | Digital Power Failure output. | T7 |
| 20 | 108/2 | CD | Input | Data Terminal Ready (DTE). An on condition prepares the modem to be connected to the telephone dial-up line. An off condition disconnects the modem from the telephone dial-up line. | D |
| 21 | 110 | CG | Output | Signal Quality Detector. An on condition indicates signal received with no probability of error. An off condition indicates reasonable probability of error. | — |
| 22 | 125 | CE | Output | Ring Indicator. Indicates that modem location has been called. | D |
| 23 | 111 | CH | Input | Data Signal Rate Selector. An on condition selects 4800 bps data speed rate. An off condition selects different data speed rate. | — |

*Table 3-4: Receptacle J1 (DTE) Pin/Signal Assignments - B Chassis (continued)*

| PIN NO. | CCITT V.24 SYMBOL | RS232 SYMBOL | INPUT/ OUTPUT | FUNCTION | FEATURE |
|---|---|---|---|---|---|
| 24 | 113 | DA | Input | TX Clock | — |
| 25 | — | — | Input | Control 6. Input control bit for monitoring the state of external equipment (TTL level). | T7 |

# SECTION 4

# OPERATION

## GENERAL INFORMATION

Instructions provided in Sections 2 and 3 should be strictly followed before proceeding to operate the modem.

Before applying power to Modem MPS 48 or MPS 48 DIAL, verify that DTE; telephone line; optional equipment, if any; and ac power connectors are correctly placed and firmly seated. Also, verify that strap plugs are correctly placed and firmly seated.

## MANUAL CONTROLS AND INDICATORS

### GENERAL DESCRIPTION

Modem MPS 48 manual controls and indicators are illustrated in Figures 1-3 through 1-9. In the PC cards, manual control is provided by pushbutton switches which are depressed to the lock, "In" position; and are depressed again to the release, "Out" position. Some of these switches are of momentary action.

The PWR ON/OFF switch, at the rear of the modem, is a toggle switch. All indicators are LED (Light Emitting Diode) type. Before operating Modem MPS 48 or MPS 48 DIAL become familiar with the designation of all manual controls and indicators, and be sure to understand the function of each.

### SIGNAL QUALITY AND LINE LEVEL DISPLAY

The Receiver Display PC card (Slot N2), which is supplied with all Modem MPS 48 configurations, has LED indicators 2, 3, 4, and 5 which light to provide a "thermometer column" reading of signal quality. Further, when the LV pushbutton on the Transmitter PC card (Slot N9) is held depressed, indicators 2, 3, 4, and 5 provide a "thermometer column" reading of line level. This reading is related to (Table 2-4) strap selection H-1 (0 to $-30$ dBm receiver range) or H-2 ($-16$ dBm to $-46$ dBm, receiver range). However, Receiver Display PC card strap selection SQ-5, SQ-4, SQ-3 or SQ-2 (Table 2-1) does not affect signal quality or line level readings provided by the 2, 3, 4, and 5 indicators. Refer to Table 4-1 for the interpretation of 2, 3, 4, and 5 readings.

### BASIC MODEM PC CARDS

In the basic modem, the following PC cards have manual controls and/or indicators. Refer to Table 4-2 and Figure 4-1.

(1) Receiver Display PC Card - Slot N2.

(2) Transmitter PC Card - Slot N9.

(3) DTE Interface PC Card - Slot N10.

Additionally, the PWR ON/OFF switch is located on the rear panel, Figure 1-2.

SPECIAL FUNCTION PC CARDS

The following special function PC cards have controls and/or indicators. Refer to Table 4-3 and Figure 4-2.

(1) Secondary Channel PC Card - Slot N11.

(2) CBS/CBT Adapter PC Card - Slot N11.

(3) Transmitter PC Card with the RT Pushbutton (Figures 1-4 and 1-5) - Slot N9.

(4) Dual Channel PC Card - Slot N1.

## MODES OF OPERATION

Modems MPS 48 and MPS 48 DIAL operate in one of two basic modes: Normal, on-line mode (Figure 4-3); or Test mode. The test mode operations are discussed in Section 5, SYSTEM FAULT ISOLATION.

ON-LINE OPERATION IN PRIVATE LINE NETWORKS

To initiate data exchange in a dedicated line network, proceed as follows:

(1) Check that the modem is set for normal, on-line operation; all test switches (RO or RT, DL, AL, ET) must be in the released, "Out" position. See Figures 1-3 through 1-9.

(2) Set the PWR ON/OFF switch to ON. The PWR indicator should light, the TST indicator should be extinguished, and the DSR indicator should be on.

(3) Under these conditions, the modem is ready to send and receive data.

ON-LINE OPERATION IN DIAL-UP LINE NETWORKS

The CBS/CDT Adapter PC Card in Feature D modems provides modem coupler characteristics necessary to operate with a standard telephone set, on 2-wire dial-up (DDD) telephone lines. The three switches in this card (Table 4-3) permit telephone line connection to the modem (DAta mode) or the telephone set (VOice mode), and Automatic Answer connect or disconnect. The operation procedures are related to the telephone line installation, as illustrated in Figures 3-14, 3-15 and 3-16.

A. **Manual Operation.** In installations equipped with a coupler type CDT (Figure 3-14) or a coupler type CBS wired for manual operation (Figure 3-16) proceed as follows to originate or receive calls:

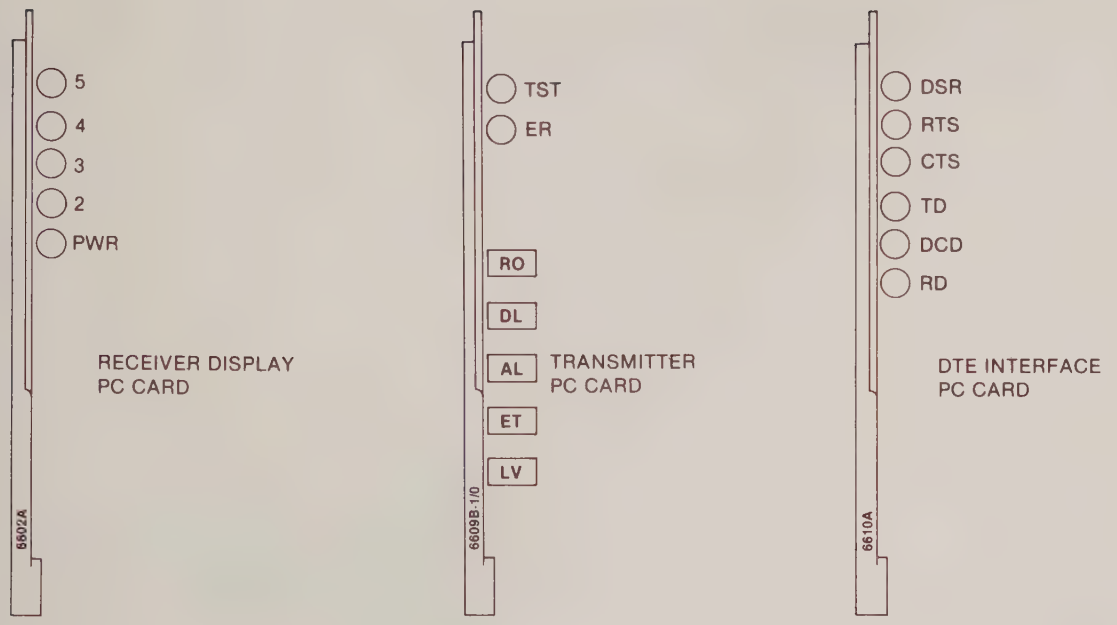



*Figure 4-1: Basic Modem PC Cards with Manual Controls and Indicators*

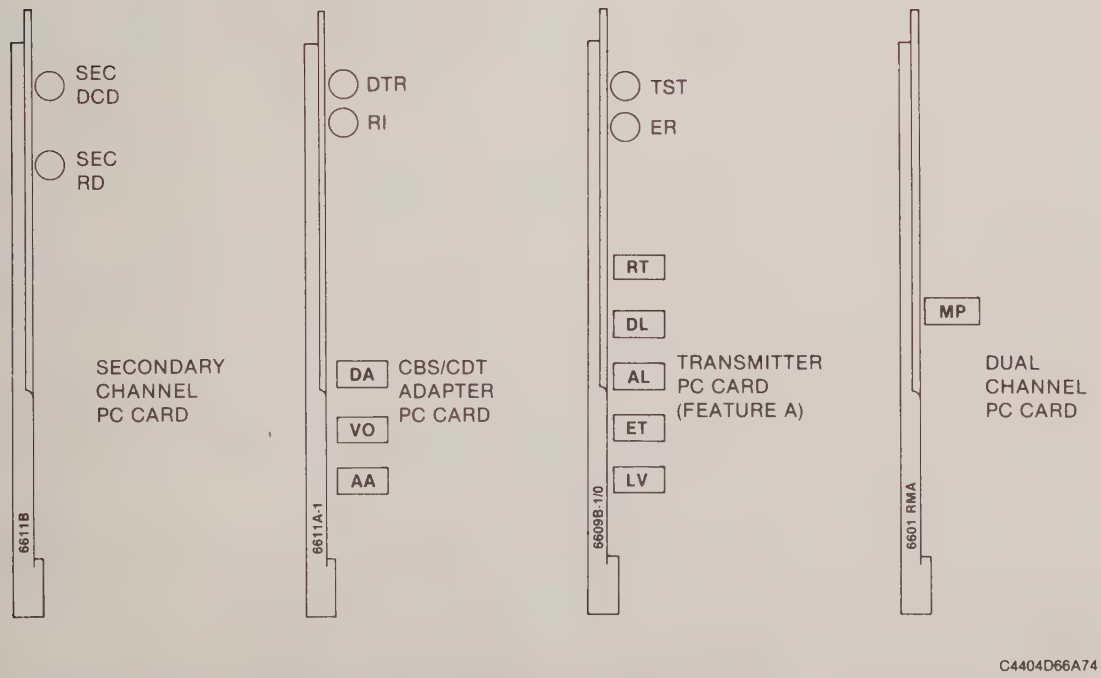



*Figure 4-2: Special Function PC Cards with Manual Controls and Indicators*

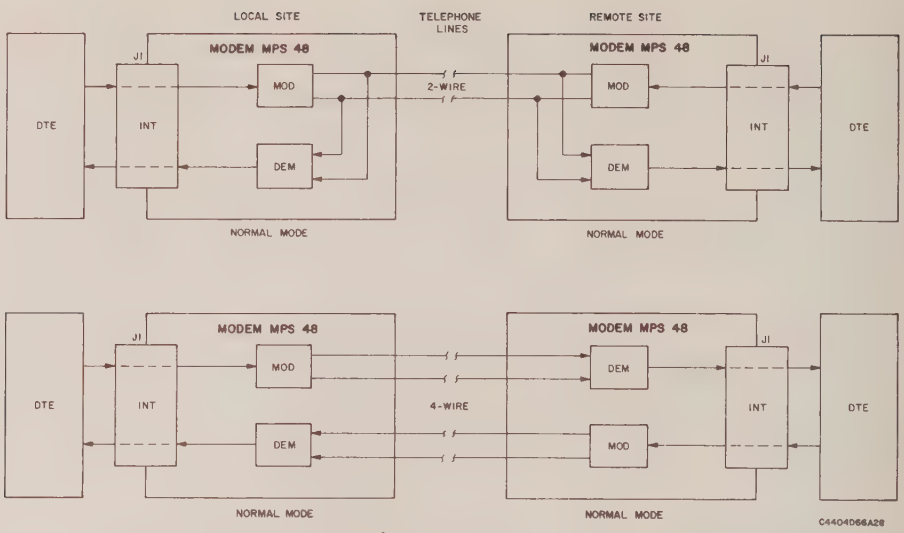



*Figure 4-3: Typical 2-Wire and 4-Wire Point-to-Point System Configuration, Normal Operation*

(1) Lift the handset and pull the exclusion key fully up. Dial the call to establish voice communication with the far-end attendant, or to answer a call when the telephone has rung.

(2) Agree with far-end attendant to go on Data mode. Ensure that the DTR indicator at both ends is lighted. The DSR indicator should be off.

(3) Place handset on its cradle, as done when "hanging up".

(4) Two seconds later, the DSR indicator should light. This denotes that data exchange has begun.

(5) When data exchange is completed, the disconnect operation is fully automatic; first, the DTR indicator extinguishes; then, the DSR indicator also extinguishes.

(6) If for some reason the DTR fails to be extinguished when data exchange is known to be completed, the attendant momentarily depresses the VO switch (Figure 1-9).

(7) At this time, the operator may place the handset on its cradle; or pull the exclusion key fully up, if it is desired to re-establish voice communication.

**B. Automatic Operation.** In installations equipped with coupler type CBS wired for automatic operation (Figure 3-15) proceed as follows to originate or receive calls:

(1) Lift the telephone handset and pull the exclusion key fully up. Dial the call to establish voice communication with the far-end attendant, or to answer a call when the telephone has rung.

(2) Agree with far-end attendant to go on Data mode. Ensure that the DTR indicator at both ends is lighted. The DSR indicator should be off.

(3) Place handset on its cradle, as done when "hanging-up".

(4) Two seconds later, the DSR indicator should light. This denotes that data exchange has begun.

(5) When data exchange is completed, the disconnect operation is fully automatic: first, the DTR indicator extinguishes; then, the DSR indicator also extinguishes.

(6) If for some reason the DTR fails to be extinguished when data exchange is known to be completed, the attendant momentarily depresses the VO switch. (Figure 1-9).

C. **Unattended Service - Auto Answer.** Depress the AA switch on the modem front panel (Figure 1-9) whenever the modem is required to automatically respond to data exchange calls.

## OPERATION WITH FEATURE B+S2 SECONDARY CHANNEL

The Secondary Channel PC card may be strapped to transmit under one of five different conditions (refer to SA strap in Table 2-6):

(1) Transmit and receive independently from primary channel operation (Strap SA-1).

(2) Transmit, only when the primary channel is not transmitting (Strap SA-2).

(3) Transmit, only when the primary channel is also transmitting (Strap SA-3).

(4) Transmit continuously (Strap SA-4).

(5) Transmission inhibited (Strap SA-5).

When the secondary channel is transmitting, the RTS indicator on the PC card lights. When the secondary channel is receiving a detectable carrier (390 Hz or 450 Hz), the SEC DCD indicator on the PC card lights. When the secondary channel is receiving a "space", the SEC RD indicator on the PC card lights.

The secondary channel circuits also generate a 1 Hz dot pattern (2 bps) test signal. In 4-wire networks, this signal is transmitted and received when the modem is in ET mode.

## OPERATION WITH FEATURES M2 AND M2+Y4 - DUAL-CHANNEL RTS/DCD SIMULATION

**Dual-Channel On-Line Operation** (Figure 4-4) is performed in one of three modes: Mode 1, Mode 2, or Mode 4. Mode 1 and Mode 2 are strap selectable (Table 2-10, Strap LK6) and prevail when the MP pushbutton switch (Figure 4-2) is in the released "Out" position. Mode 4 prevails when the MP pushbutton switch is in the locked, "In" position.

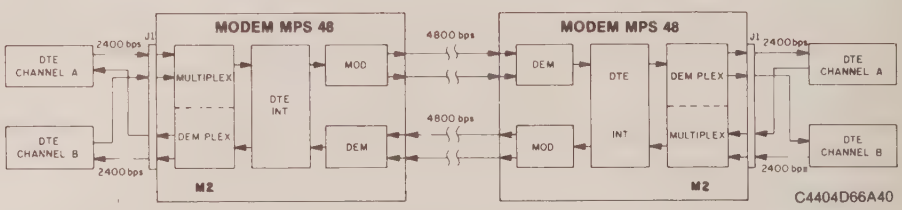



*Figure 4-4: Four-Wire Point-to-Point System with Dual-Channel Feature M2, Normal Operation*

In Mode 1, the Dual-Channel circuits use Channel A only for transmission and reception. Channel A receiver may use an external RX clock signal (Table 2-10, strap LK3) for clock retiming.

In Mode 2, Channel A only is used for transmission and reception. When RTS/DCD simulation is available, Channel A RTS-CTS delay can be set to 1.0, 7.4, or 16.3 ms with strap LK11. No clock retiming is available in Mode 2 operation.

In Mode 4, Channel A and Channel B operate as described for Features M2 and M2+Y4. Channel strap settings are as follows:

| | Channel A Straps | Channel B Straps |
|---|---|---|
| TX Clock Retiming Int. | LK4 (1-2) | LK7 (1-2) |
| TX Clock Retiming Ext. | LK4 (1-3) | LK7 (1-3) |
| RTS-CTS Delay | | |
| 1.9 ms | LK11 (1-2) | LK10 (1-2) |
| 14.8 ms | LK11 (1-3) | LK10 (1-3) |
| 28.2 ms | LK11 (1-4) | LK10 (1-4) |

Refer to Dual-Channel Test Operation in Section 5.

*Table 4-1: Signal Quality and Line Level Display Interpretation*

| INDICATORS ON | INDICATORS OFF | READING |
|---|---|---|
| **A. SIGNAL QUALITY (LV Pushbutton Released)** | | |
| 2 only | 3, 4, and 5 | Bit error rate is approximately 1 bit in $10^4$ bits |
| 2 and 3 | 4 and 5 | Bit error rate is approximately 1 bit in $10^5$ bits |
| 2, 3 and 4 | 5 only | Bit error rate is approximately 1 bit in $10^6$ bits |
| 2, 3, 4 and 5 | none | Bit error rate is less than 1 bit in $10^6$ bits |
| **B. LINE LEVEL (LV Pushbutton Depressed)** | | |
| 2 only | 3, 4 and 5 | With H-1 strap, −16dBm to −31dBm<br>With H-2 strap, −26dBm to −41dBm |
| 2 and 3 | 4 and 5 | With H-1 strap, −6dBm to −16dBm<br>With H-2 strap, −16dBm to −26dBm |
| 2, 3 and 4 | 5 only | With H-1 strap, +4dBm to −6dBm<br>With H-1 strap, −6dBm to −16dBm |
| 2, 3, 4 and 5 | none | With H-1 strap, +14dBm to +4dBm<br>With H-2 strap, +4dBm to −6dBm |

*Table 4-2: Basic Modem PC Cards, Manual Controls and Indicators*

| NAME | POSITION | FUNCTION |
|---|---|---|
| **RECEIVER DISPLAY PC CARD - Slot N2** | | |
| 2, 3, 4, 5 Indicators | — | Refer to Table 4-1 for interpretation of readings provided by these indicators.<br><br>Switch LV (in the Transmitter PC card) must be released to read signal quality from these indicators.<br><br>With switch LV depressed, these indicators read line level. |
| PWR Indicator | — | Lights to indicate that the modem circuits are energized. |
| **TRANSMITTER PC CARD - Slot N9** | | |
| RO (Receive Only) Switch (Figures 1-6, 1-7, 1-8, 1-9) | In | Modem Transmit function is disabled.<br><br>RTS and CTS functions are inhibited.<br><br>CTS indicator is off; RTS indicator will light if DTE sends a RTS command.<br><br>TST indicator should flash. |
| | Out | RO test mode is disabled. |
| DL (DTE Loopback) Switch | In | The modem goes into digital loopback test.<br><br>When the RT switch (Table 4-3) is also "In", the local modem forces the far end modem into DL test.<br><br>TST indicator should flash. |
| | Out | DL test is disabled. |
| AL (Analog Loopback) Switch | In | The modem goes into analog loopback test.<br><br>When the RT switch (Table 4-3) is also "In", the local modem forces the far end modem into AL test.<br><br>TST indicator should flash. |
| | Out | AL test is disabled. |
| ET (Error Test) Switch | In | The modem is enabled to transmit and/or receive a scrambled "I's" test pattern only.<br><br>DTE interface signals are disabled.<br><br>TST indicator should flash. |
| | Out | Error Test is disabled. |

*Table 4-2: Basic Modem PC Cards, Manual Controls and Indicators (continued)*

| NAME | POSITION | FUNCTION |
|---|---|---|
| LV (Line Level) Switch | Momentary Action | This switch is depressed to read line level on the Receiver Display PC card indicators. Refer to Table 4-1.<br><br>When LV switch is released, the Receiver Display PC card indicators show signal quality. |
| TST (Test) Indicator | — | Flashes to indicate that the RO (or RT), DL, AL, or ET pushbutton switch is in the locked, "In" position, and the modem is in the test mode. |
| ER (Error) Indicator | — | Flashes to indicate error(s) received in the scrambled I's test pattern. |
| **DTE INTERFACE PC CARD - Slot N10** | | |
| DSR Indicator | — | Lights to indicate that the Data Set Ready signal is on. |
| RTS Indicator | — | Lights to indicate Request to Send condition from DTE is on. |
| CTS Indicator | — | Lights to indicate Clear to Send on condition sent to DTE. |
| TD Indicator | — | Lights to indicate that the Transmit Data signal on J1-2 is in SPACE condition (+V). |
| DCD Indicator | — | Lights to indicate that the Data Carrier Detected signal on J1-8 is on (+V). |
| RD Indicator | — | Lights to indicate that the Receive Data signal on J1-3 is on SPACE condition (+V). |

*Table 4-3: Special Function PC Cards, Manual Controls and Indicators*

| NAME | POSITION | FUNCTION |
|---|---|---|
| **SECONDARY CHANNEL PC CARD - Slot N11** | | |
| SEC DCD Indicator | — | Lights to indicate that the secondary channel is receiving a signal. |
| SEC RD Indicator | — | Lights to indicate Receive Data in the secondary channel. Primarily, this indication denotes the received test pattern signal which is the slow dot pattern. |
| **NOTE:** Operation of the SEC DCD and SEC RD indicators is not affected when the modem goes into Error Test (ET) mode. | | |
| **CSB/CDT ADAPTER PC CARD - Slot N11** | | |
| DA Switch | Momentary Action | The DAta switch is depressed to transfer the telephone line from the telephone set to the modem. |
| VO Switch | Momentary Action | The VOice switch is depressed to transfer the telephone line from the modem to the telephone set. If the telephone set is "on hook" during this transfer, disconnect occurs, and the line is dropped. |
| AA Switch | In | The modem provides Automatic Answer to incoming calls. |
| | Out | The modem does not answer incoming calls. |
| DTR Indicator | — | Lights to indicate that the Data Terminal Ready signal (CCITT 108/1 or 108/2) is on. |
| RI Indicator | — | Lights upon receipt of a telephone ringing signal. |
| **TRANSMITTER PC CARD - Slot N9** | | |
| RT (Remote Test) Switch (Figures 1-4 and 1-5) | In | The RT pushbutton is depressed to enable remote DL or remote AL test when operating with point-to-point test, Feature A modem. |
| | Out | Remote test is disabled. |
| **NOTE:** Other controls and indicators of the Transmitter PC card are described in Table 4-2. | | |
| **DUAL CHANNEL PC CARD - Slot N1** | | |
| MP (Multiplexer) (Figures 1-5 and 1-8) | In | The MP pushbutton depressed enables dual-channel operation, Mode 4. |
| | Out | The MP pushbutton released causes Channel A single operation, at 4800 bps, in Mode 1 or Mode 2. |

# SECTION 5

# SYSTEM FAULT ISOLATION

## GENERAL INFORMATION

Modem MPS 48 and MPS 48 DIAL have built-in test circuits which provide loopback control and test pattern generation and comparison. These circuits are manually activated for one of two reasons: to verify modem operation during scheduled checks, or to isolate a system malfunction.

System malfunctions are commonly indicated by a high rate of errors in data received by the associated DTE. For example, excessive NAK (negative acknowledgement) count or excessive block retransmitted count.

At times, system malfunction is indicated by "catastrophic" failure. For example, sudden loss of carrier signal detection (DCD). The sources of "catastrophic" failures may range from the modem ac power connector being accidentally disconnected from the outlet, to the break of a transmission line at considerable distance from the site.

**NOTE**

Under all circumstances, the DTE personnel must be notified before placing the modem in test mode. Failure to do so may result in serious disruption of data handling at the customer site.

## LOCAL TEST FUNCTIONS

The test functions built into a MPS 48 modem consist of loopback controls and test pattern generation and comparison. Loopback controls connect modem transmitter and receiver in a looped data path which may be used for local test or to link two distant modems. The test pattern circulates through the loopback path to exercise and check modem normal functions.

Any of the four following test functions may be activated by depressing the corresponding pushbutton on the modem front panel.

RO — Receive Only (available in all MPS 48 modems, except Feature A) disables modem transmitter. In half-duplex testing permits only one-way (incoming) communication from a far-end modem. (Figure 5-1).

DL — Digital Loopback. Causes two local loop actions (Figure 5-2): the receiver output is connected to the transmitter input and the transmit data (TD) input from the DTE is connected to the receive data (RD) output to the DTE.

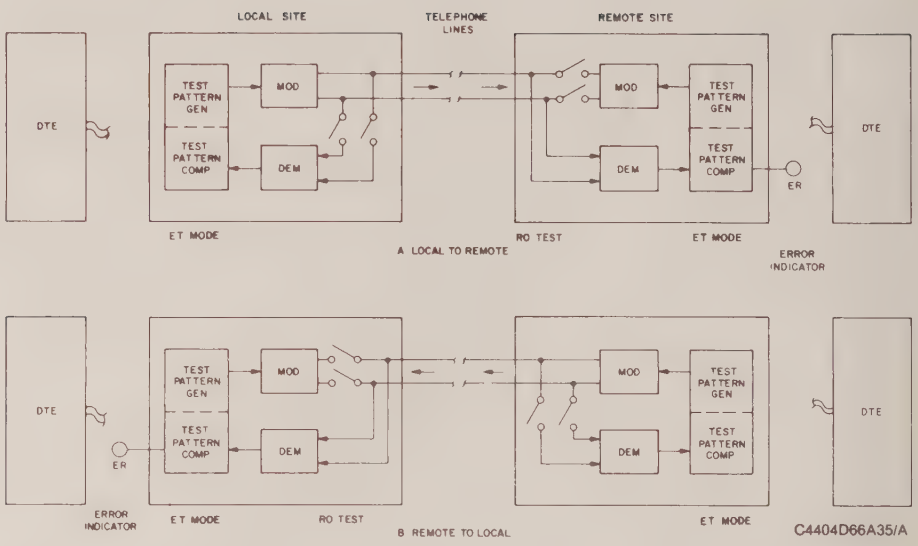
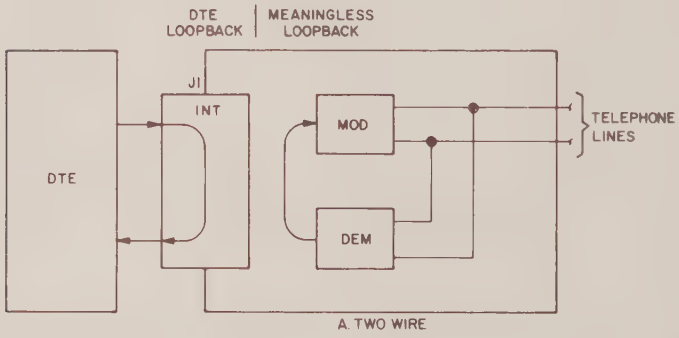



*Figure 5-1: Two-Wire End-to-End Test with ET and RO Facilities*



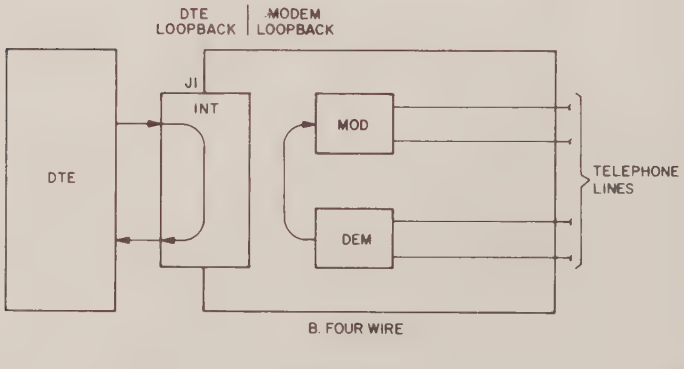
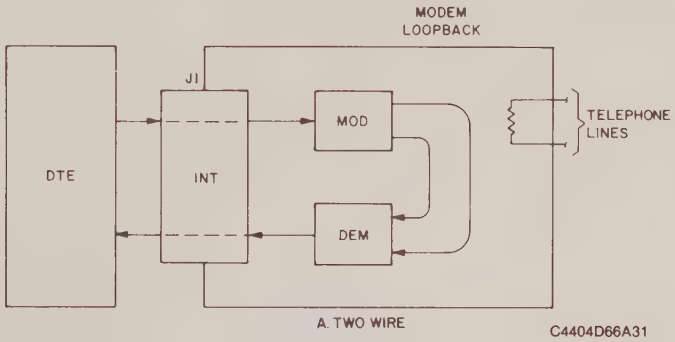




*Figure 5-2: Digital Loopback*

AL

Analog Loopback. Causes two loop actions at the originating modem (Figure 5-3): The transmitter output is connected to the receiver input. And, in 4-wire circuits, the receive pair line is normally looped to the send pair. However, this loop may be disabled at customer option (refer to TRANSMISSION LINE CONSIDERATIONS, Analog Gain Loopback Control).



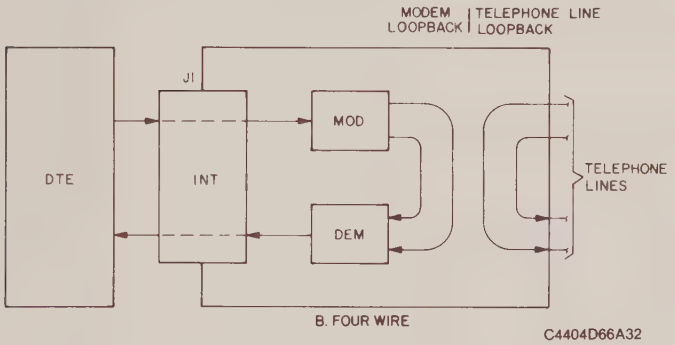




*Figure 5-3: Analog Loopback*

ET

Error Test. Activates the 511 test pattern generator and comparator. The generator is connected to the transmitter and the comparator is connected to the receiver. In this condition, the modem may be self tested with an Analog Loopback. When a local loopback is not required the test pattern may be transmitted and looped at a far-end modem. See Figures 5-6 and 5-7.

MODEM SELF TEST

The correct performance of a modem can be quickly and reliably verified by self test. In this state, the modem is isolated from its network environment to test its own transmission and reception functions.

In self test (Figure 5-4), the 511 test pattern from the pattern generator starts a simulated digital data which goes through the transmitter and re-enters the receiver as an analog signal. The receiver converts the test pattern signal to its original digital format and presents it to the test pattern comparator. Errors returned to the comparator cause the ER indicator to flash.

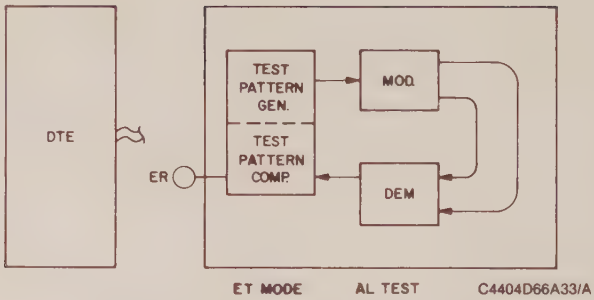



*Figure 5-4: Modem Self Test*

Proceed with the test as follows:

(1) With power turned on depress the ET and AL pushbuttons. The TST indicator should light.

(2) Except for an initial flash, the ER indicator should not light at all in modem self test. Since the test pattern travel is restricted to internal modem circuits, no allowance is made for errors.

(3) Release the AL pushbutton.

(4) At the Transmitter PC card set the transmit carrier level for – 16dBm (straps E-16, F-1), and the receive level for – 0 to 30 dBm range (strap H-1). Refer to Table 2-4.

(5) Place two wire jumpers at TB1 on the rear panel, thus:

These jumpers extend the analog loop (AL) to include the transmission line interface.

(6) If the ER indicator lights during the first or second portion of self test, the modem is considered defective and should be replaced.

The end-modems in a communications link must pass the self test before participating in End-to-End System test.

## SYSTEM TEST FUNCTIONS

### END-TO-END TEST

System performance of the two end-modems and transmission line in a communications link can be quickly and reliably verified with an End-to-End test.

In End-to-End test (Figure 5-5) both end-modems transmit to each other the 511 test pattern. And both modems compare the received test pattern.

The error count is registered by the ER indicator at either end-modem. This error count should reflect transmission line quality only, since the end-modems must be self tested before going to End-to-End test.

For an "error free" condition, one error is allowed for every 100,000 bits of data. Due to the fast data bit rate, however, one flash of the ER indicator may denote up to 3 errors. Therefore, in a 3-minute (864,000 bits) test, the ER indicator is allowed to flash a maximum of 3 times and still denote an "error free" condition.

Proceed with End-to-End test as follows:

(1) Use voice communication to agree with a remote site operator to go on an End-to-End test. Request the operator to depress only the ET pushbutton. This causes the test pattern to be transmitted by the far-end modem.

(2) At the local modem, check that the DCD indicator lights. This denotes that the test pattern carrier signal from the far-end modem is being received.

(3) At the local modem, depress the ET pushbutton. Now local and far-end modems are in an End-to-End test, as shown in Figure 5-5.

(4) At the local modem, conduct the three-minute error count. Refer to CONFIDENCE TESTS.

(5) Since the two modems involved in the test have individually passed the self test, transmission line malfunction may be suspected in case of excessive errors.

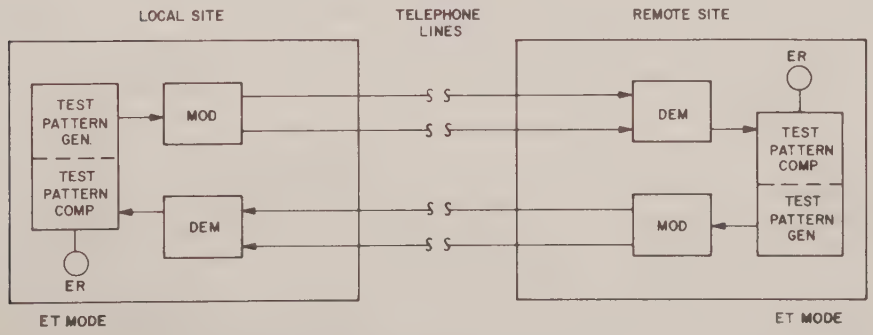



*Figure 5-5: End-to-End System Test*

## REMOTE POINT-TO-POINT TEST

Feature A and Feature A + M2 modems (Figures 1-4 and 1-5) are equipped with the Remote Point-to-Point Test function. This function is activated with a combination of three pushbuttons on the front panel. RT, AL, and ET; or RT, DL and ET. The first combination causes an analog loopback to be formed at the far-end modem. The second combination causes a digital loopback. See Figures 5-6 and 5-7.

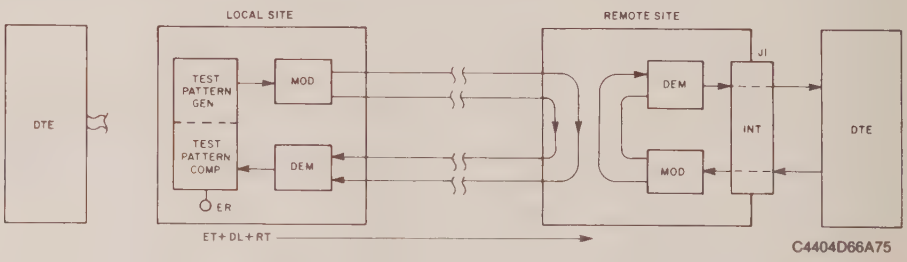



*Figure 5-6: Remote Analog Loopback*

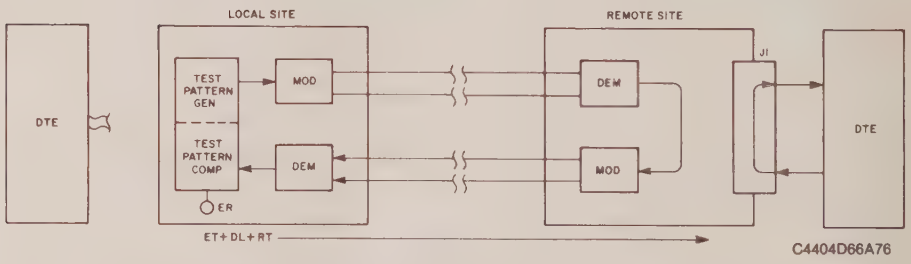



*Figure 5-7: Remote Digital Loopback*

The ET pushbutton is depressed at the originating modem to circulate a test pattern through the remote analog or digital loop. Results of the test are given by error count and display indicator analysis.

## REMOTE MULTIPOINT TEST

In a 4-wire multipoint network, the central site modem is connected at J2 to a Model 160 Multipoint Tester (MT); and the remote site modems must be MPS 48, Feature B + T3 to conduct remote AL and DL tests (Figure 5-8).

The central site must meet the following requirements:

(1) Use a basic Modem MPS 48 and use Cable Part No. 4402-601E-6 to connect Model 160 MT to receptacle J2 at the rear of the modem. When the modem is used in this configuration. Transmitter PC card, Part No. 4404-6609A-3, must have jumper JW4 installed (Table 2-4).

(2) Set the Model 160 MT for the remote modem address, and the desired test, AL or DL. Use of pilot tone is neither required nor desired.

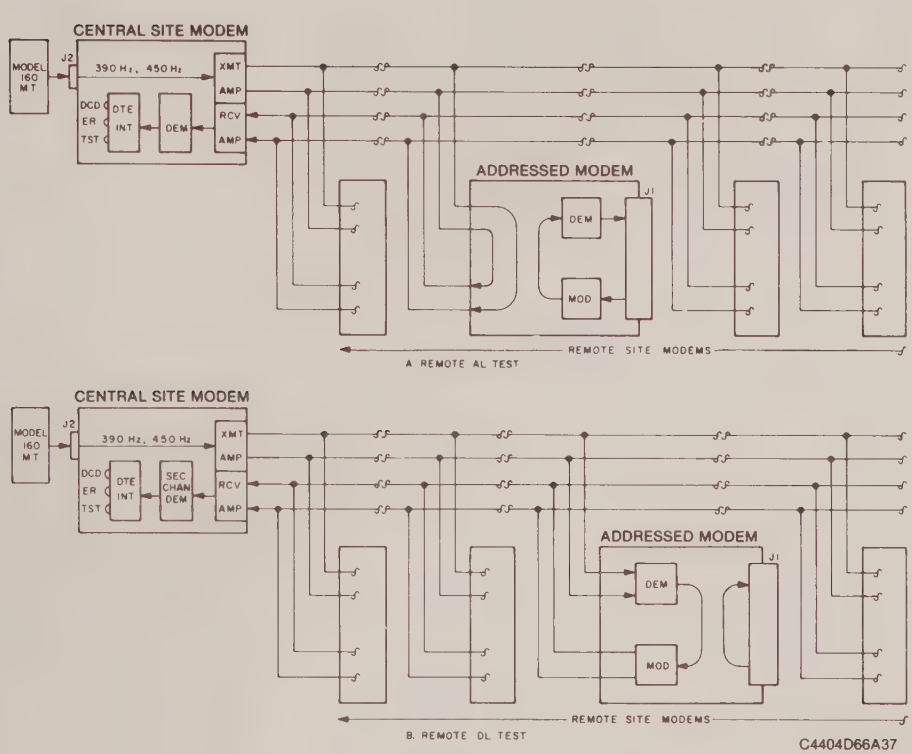



*Figure 5-8: Remote Multipoint Test*

The remote site Modems MPS 48, Feature B + T3 are equipped with the Remote Multipoint Test PC card (Slot N11), which has been strapped for the address code assigned to each remote site. Refer to Table 2-7.

When the test starts, the following process takes place:

(1) With power on and set for remote test operation, Model 160 MT causes the central site modem to go on test.

(2) Model 160 MT performs as a transmitter device which generates a 75 bps signal on a 420 Hz centered FSK carrier. This signal conveys the address code and the remote test (AL or DL) code.

(3) The addressed Modem Feature B + T3 receives the command at a secondary channel demodulator and sets the modem to AL or DL test.

(4) Feature B + T3 modem does not transmit secondary channel data to central site. However, the central site modem and the addressed modem being set to test, permits the two modems to perform in a loopback configuration.

(5) All other non addressed remote site modems are inhibited from receiving or transmitting data while the remote test is in progress.

## MULTIPOINT TEST AND CONTROL

The Multipoint Test and Control (T7) PC card circuits operate automatically (no manual control on the modem) in a 4-wire network, under control of a System 185 or System 200 NDC connected to the central site modem.

The T7 PC card contains a transmitter, receiver and microprocessor which operate an asynchronous secondary channel between central site and remote site modems equipped with the T7 PC card; thus, from the central site, the NDC can monitor and test the performance of a remote site modem (Figure 5-9). Also, certain alarm conditions originated at a modem in the multipoint network can be transmitted as mayday messages to the NDC.

Mayday messages include Customer Alarm, Streaming, Receive Line Fault, Modem Failure and Dedicated Line not Restored.

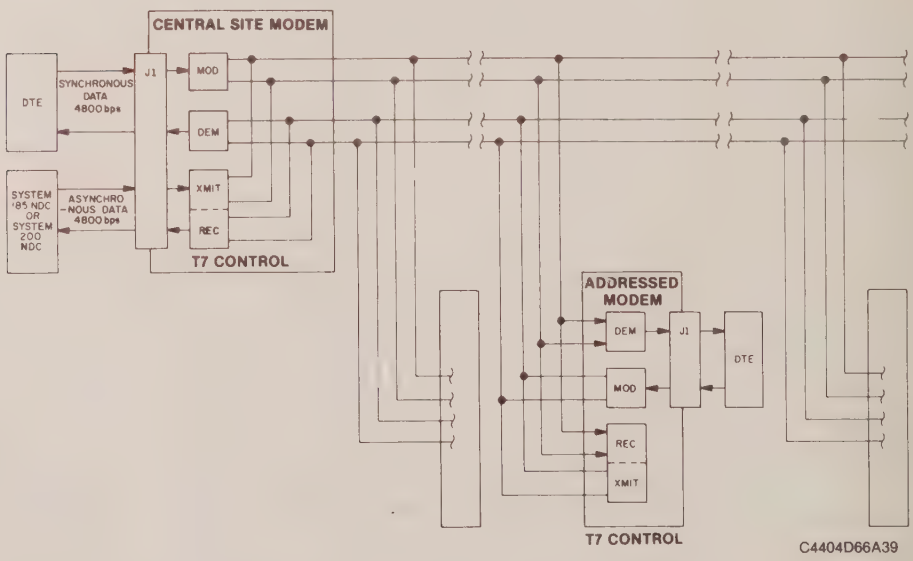



*Figure 5-9: Multipoint Test and Control*

With the exception of Receive Line Fault, which is transmitted on a one-shot basis for 8 to 18 seconds, all other mayday messages are transmitted continuously until terminated by NDC command.

NDC commands processed by the T7 feature fall into one or two general classes: test modem commands, or control commands. The main test mode commands are:

(1) Self Test

(2) End-to-End Test

(3) AC Loopback with or without test pattern

(4) DC Loopback with or without test pattern

(5) Interface Status Monitor

Self Test mode affects the modem under test, only. End-to-End, AC Loopback and DC Loopback interrupt all traffic in the communications line related to the modems conducting the test. The Interface Status Monitor does not interrupt traffic.

Control commands are as follows:

(1) Squelch Primary TX (STP). This command is issued in response to a Streaming mayday message, to turn off the remote site modem transmitter and, thereby, stop the streaming condition which precludes communication with other remote sites in the network.

(2) Simulate Power Failure (SPF). This command serves to test the remote site modem ability to generate a Modem Power Failure mayday message. Upon receipt of SPF, the remote site should respond with Modem Power Failure.

(3) Return to Normal (RTN). This command is issued to terminate all test mode command operations, normalize remote site test controls, and resume normal data traffic.

(4) Inhibit Test and Control (ITC). When this command is issued, no test mode commands are accepted by the T7 circuits in the network modems. Thus, the T7 asynchronous secondary channel can be used for normal data exchanges. ITC is terminated with a RTN command.

Through the T7 control circuits, the NDC may perform line switching (dedicated to dial-up or vice versa) on central and remote site modems connected to an automatic line adapter. Refer to Instruction Manual, Part No. 4404D121A1, Model 121A Auto Line Adapter (ALA).

For ALA operation, the following control commands are issued by the NDC.

(5) Switch to Dedicated Line (SDL).

(6) Switch to Dial Back-up (SDB).

(7) Disconnect Dial Lines (DDL).

Additionally, the remote site B + T7 modem may transmit the Dedicated Line not Restored mayday message. This message becomes necessary during the dial to dedicated switching process when the restored dedicated line does not function properly.

DUAL-CHANNEL TEST

In Feature A + M2, A + M2 + Y4, C + M2 and C + M2 + T7 modems, the Point-to-Point Test control allows the modem operator at the local end to depress the RT and DL pushbutton, which forces the modem at the far end to go into digital loop. This condition, illustrated in Figure 5-10, causes the dual-channel circuits to operate single channel, Mode 1 or Mode 2, as strapped.

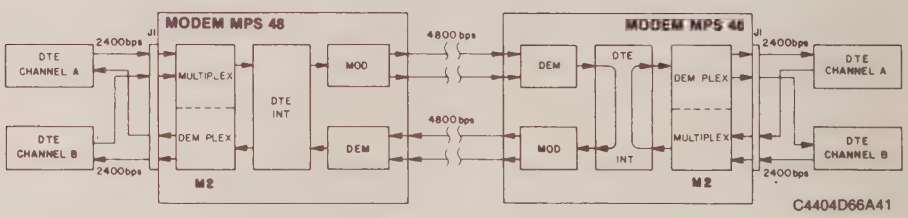



*Figure 5-10: Dual-Channel Test*

Single channel operation also results at the modem, local or remote, where either or both RT and DL pushbuttons are depressed to the locked, "In" position.

**SYSTEM FAULT ISOLATION**

When system malfunction occurs, start searching for the source of the problem at the most accessible portion of the network. In most cases, this will be the modem. Perform your search in a logical, progressive manner; for example:

(1) Check modem installation

- PWR indicator on.

- Cable connectors firmly set and secured

- Transmission lines correctly and firmly connected

(2) Conduct a modem self test (Figure 5-4)

Once the modem is determined to be operating correctly, proceed to eliminate other portions of the network.

POINT-TO-POINT NETWORK CHECKS

In a direct point-to-point configuration, consider that data transmission must be interrupted for the tests. However, the testing scheme is uncomplicated and brief.

Perform modem self test (Figure 5-4) at both ends to eliminate the modems as the source of malfunction. Next, perform an end-to-end system test (Figure 5-5) to check transmission line performance. Determine error count as described in CONFIDENCE TESTS.

MULTIDROP NETWORK CHECKS

In a Multidrop Network, if one drop only is running poor data, initially suspect the transmission line drop, the modem and the DTE. Self test the modem. Set a digital loop (DL) in the modem to self test the DTE; see Figure 5-2. By testing modem and DTE first, it may not be necessary to shut down the entire network to test transmission lines.

When all data in the multidrop network appear to run poorly, initially suspect the central site modem and DTE, as well as the main transmission lines. To approach this condition more effectively, first self test modem and DTE at the farthest drop. Next, self test central site modem and DTE. When modems and DTEs check satisfactorily, set up an end-to-end system test and determine error count between farthest modem and central modem. This test will reveal the main transmission line performance.

COMPLEX NETWORK CHECKS

In more complicated network configurations, quickly analyze the malfunction by answering the following questions:

(1) In what area of the network does the problem seem to appear?

(2) Can that area be isolated and tested without interrupting data transmission throughout the network?

(3) What is the easiest and quickest method to test that area if, in fact, the network must be shut down?

**FIELD SUPPORT**

Modems MPS 48 and MPS 48 DIAL provide high reliability through the use of Large Scale Integration (LSI) circuits, solid state components, and conservative rating of the components. Nevertheless, after careful checks and tests, as described in this section, a system fault may occasionally be traced to the modem. In that case, contact Racal-Milgo Customer Support for service assistance.

When contacting Racal-Milgo Customer Support for service assistance, be sure to mention the identification provided on the nameplate on the rear of the modem.

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